JPRS 81037

14 June 1982

Worldwide Report

ENVIRONMENTAL QUALITY

No. 356

China Addresses Environmental Issues

FBIS FOREIGN BROADCAST INFORMATION SERVICE

JPRS 81037

14 June 1982

Worldwide Report

ENVIRONMENTAL QUALITY

No. 356

China Addresses Environmental Issues

FBIS FOREIGN BROADCAST INFORMATION SERVICE

JPRS 81037

14 June 1982

WORLDWIDE REPORT

ENVIRONMENTAL QUALITY

No. 356

CHINA ADDRESSES ENVIRONMENTAL ISSUES

CONTENTS

INCORPORATING ENVIRONMENTAL PROTECTION INTO ECONOMIC PLANNING SUGGESTED

Beijing HUANJING BAOHU [ENVIRONMENTAL PROTECTION] in Chinese No 5, 1981 pp 1-3

[Article by Gao Yusheng [7559 1342 5116]: "How Can We Do a Better Job of Incorporating Environmental Protection Into the National Economic Plan?"]

[Text] We have already entered the 1980's, and people's governments and cognizant departments at all levels are drafting short-term, mid-term and long-term plans for economic development to implement the four modernizations. How to do a better job of incorporating environmental protection into the national economic plan is an important issue for planners and environmental protection personnel.

In the past few years, our environmental protection work has progressed more slowly than in industrially developed western capitalist countries, which seems anomalous. Since our socialist system is superior to the capitalist system and stresses responsibility to the people, our environmental protection work should be done better. Why, then, are we behind? Some believe that this is because our environmental protection work has not been incorporated into the national economic plan and accordingly urge its incorporation into this plan so as to make it progress more rapidly. But is our environmental protection work indeed not included in the national economic plan at present? Is environmental work sure to develop faster if it is included in the economic plan? How should we incorporate it into the national economic plan? Only by clarifying these questions can we make the right prescription and solve the real problem.

1. Is Our Country's Environmental Protection Work Included in the National Economic Plan?

Socialism is the system of public ownership of the means of production, based on economic planning, and if any activity is not included in state planning, it cannot progress. Environmental protection is no exception. In this respect, we can say that inclusion of environmental protection work in national economic planning is one of the characteristics of environmental protection in a socialist country.

As everyone knows, the scope of environmental protection is very broad; according to the definition given in the "(Provisional) People's Republic of China Environmental Protection Law" promulgated in 1979, the environment

includes the air, water, soil, mineral deposits, forests, grasslands, wild animals, wild plants, water life, famous antiquities, scenic spots, hot springs, baths, natural protection districts, residential areas and the like. In order to protect this environment, we must conduct environmental protection work. The specific nature of environmental protection is also specified by the state environmental protection law. For example, rational land use and soil improvement, protection of the water quality of rivers, lakes, seas and reservoirs, rational development of mineral resources; protection of forest resources, afforestation, protection against the environmental pollution and harm produced by industrial and municipal liquid, gaseous and solid wastes, dust, garbage, radioactive materials, noise, vibration and foul odors, development of clean fuels and clean energy sources, improvement of municipal sewage systems, establishment of sewage treatment areas, development of highly effective, low-toxicity agricultural pesticides, prevention of food pollution and the like are all part of environmental protection. For many years our country has included all of these activities in the national economic plan, but some were included under the name of environmental protection and others were included under other names. Starting in the 1970's, government organs and departments at all levels set up environmental protection organizations which have further strengthened environmental protection awareness and planning.

At present, China's environmental work is included in the national economic plan in three main ways. First, each year when the central government arranges its capital construction budget, it allocates special grant funds for environmental protection work, and the central government's environmental protection departments propose projects to be included in the capital construction plan. Second, when the central government organizes the budgets of the departments in the State Council and the various provinces and municipalities, these include environmental protection funds, and the various departments in the State Council and the provinces and cities propose capital construction projects for inclusion in the capital construction plans. Third, the various provinces and municipalities, departments and basic-level units set aside certain sums (including renovation for technology fund) for use in environmental protection and specify control projects to be included in the local economic development plans. For example, in 1981, the Beijing City Economic Committee's system alone allocated 18 million yuan of renovation for technology fund to be used for as grants for pollution control in enterprises, in addition to which it included economic projects in the 1981 economic development plans which it handed down. Even so, this country's environmental protection work has still been proceeding slowly in recent years.

This makes it clear that the present problem is not that environmental protection work has not yet been incorporated in national economic plans.

2. The Key to the Present Problem Is Readjustment of the Proportional Share of Environmental Protection in the Economic Plans

Since this country's environmental protection work has in fact been included in the national economic plans, why is environmental protection in this country, a socialist country, not developing as fast as in capitalist countries?

The socialist system only provides the potential for effective environmental protection; it does not make it a certainty. To make this potential a reality, government organizations, relevant departments at all levels and the basic-level units all must conscientiously intensify their environmental protection work. An important question which now requires a solution is that of suitably adjusting the proportional share of environmental protection work in the national economic plan.

In the past, we underestimated the importance of environmental protection and lacked experience in ways of protecting the environment, and in addition our country's economic development was lagging, the people's standard of living was low, and the country was rushing to step up production; as a result, in arranging the national economic plan little importance was accorded to organizing environmental protection. Just as in the past there was a loss of proportion between industry and agriculture and between light and heavy industry in national economic planning, we also had a serious loss of proportion between development of production and organization of environmental protection. Because developing production was overemphasized and environmental protection was underemphasized, a few years ago our environmental protection budget amounted to less than 1 percent of the total output value of the national economy, while in several western capitalist countries the proportion of gross national product budgeted for environmental protection in 1971-1975 was as follows: 1.6 percent in the United States, 1.3 percent in Japan, and 1.8 percent in West Germany. In absolute terms, we did even less. Although the funds allocations are not entirely comparable, generally ours are still rather low. Because our investment in environmental protection was rather small, for many years long-standing pollution problems were far from being solved and new types of pollution were increasing, so that our arrearage mounted higher and higher: this is an important reason why our country's environmental protection work has developed slowly.

The tasks currently facing environmental protection work in this country are to systematically make up the large historical pollution debt, and to actively protect against new types of pollution; these tasks are extremely arduous. Given the current organization of environmental protection work in our country's national economic plan, it will be quite impossible to make a major improvement in pollution in 3 to 5 years (the state requirement) or even in a longer period. Taking Beijing as an example, although a certain investment has been made in the past few years to deal with air pollution, the air quality still has not improved, and sulfur dioxide concentrations in the urban area during winter are still gradually increasing. According to a recent preliminary atmospheric pollution control plan, winter air quality will still not have improved in the urban area by 1985, because as economic and urban construction develop, pollutant emission by quantities will continue to expand, and the progress of pollution protection work will not be able to keep up with the rate of increase of pollution; this makes it quite clear that currently the key to our country's environmental protection work is readjustment of the proportional share of environmental protection in the national economic plan.

3. Striking an Overall Balance Through a Feasible Protection Plan

Although we need to suitably readjust the share of environmental protection in the national economic plan, on what basis should we readjust it? How large a share is suitable? Although we have made some comparisons with foreign countries, each country's situation is different, and we cannot copy their experience indiscriminately. Moreover, the requirements are not entirely comparable. In China, the periods of economic development are different, and we cannot treat them in entirely the same way; in addition the circumstances of the various localities and the various industries also differ in many respects. Primarily, we must proceed in terms of the state's financial resources and an environmental plan, and make the readjustment in terms of an overall balance.

This involves certain requirements. First, the various government organizations, departments and basic-level units must draft feasible environmental plans and hand them down, propose standards and measures and specify the funds required for specific periods. When we say, "feasible," we mean gradual improvement of environmental quality through treatment measures that are feasible in terms of our country's present financial resources and technological level; we do not mean a standstill as at present. This type of environmental protection plan cannot be limited to control of industrial pollution, but must, in accordance with the requirements of the state environmental protection law, include protection of the natural environmental, prevention of pollution and other nuisances, suitable arrangements to prevent new pollution and measures to deal with existing pollution, scientific research in environmental pollution and environmental monitoring work. Drafting this plan is not only the province of the environmental protection departments, but should be done with the participation of all relevant departments and coordinated by the environmental protection departments, then approved by the central government. In addition, the departments should draw up their own plans on the basis of the requirements stated in the environmental protection plan. Then, the various systems should present these plans to the central government's planning departments, and an overall balance should be drawn up and included in the national economic plan. Only this type of readjustment can bring the proportional share of environmental protection work into greater agreement with reality. Without such an environmental plan to provide the planning departments with data for the drafting of the national economic plan, there will be nothing but nebulous talk of incorporating environmental protection into the national economic plan, without any real significance.

4. The People's Governments and Relevant Departments at the Various Levels Must Include Environmental Protection in Economic Plans

After the governmental bodies and departments at the various levels have drawn up the environmental plans, they must submit to the State Council those parts which must be accomplished by the central government, and the State Council's planning departments must make budgetary arrangements for them in accordance with the comprehensive balance. The budgeted funds for environmental protection should be distributed as described below.

a. The proportion to be allocated to the state environmental protection departments will be primarily used for the establishment of environmental protection agencies and environmental management, grants to key units for pollution control, grants for regional pollution control, and scientific research and monitoring work related to environmental protection. The central government's environmental protection departments should distribute funds to environmental protection departments at the various levels, in accordance with their various circumstances, for specific uses proposed by the latter, which should be included in the various levels' economic development plans. Some urge that the environmental protection departments should have only an oversight role and should not control economic measures, but this is incorrect: the environmental protection departments have control over some of the budgetary funds, and it is right that they should use these for grants and subsidies for the environmental protection expenses of the localities and departments.

b. A portion of the budgeted funds should be allocated to the relevant departments in the State Council (e.g. industry, agriculture, communications, forestry, electric power and the like) for use by the organizations subordinate to these systems in environmental protection and pollution prevention; the relevant departments will propose projects to be included in the economic development plans.

c. The portion of the funds earmarked for the provinces and municipalities will be used for environmental protection work as part of municipal construction for example construction of sewage systems or sewage treatment plants and the construction of projects for the supply of clean fuels (such as coal gas plants) or other clean energy sources (geothermal, solar power and the like).

For the portions of the environmental protection plans which can be accomplished by the localities, the local people's governments and departments should set aside some funds (including local financial organs; funds and renovation for technology fund), and the relevant local departments and environmental protection departments should hold consultations and designate specific projects which will be incorporated into the local capital construction plans or technical modernization plans. In addition to receiving investment funds from the higher levels, the enterprises concerned must also allocate funds of their own for pollution control, and these must be included in the enterprises' annual, quarterly and monthly production plans along with the projects handed down from the higher levels.

Only by following such a procedure will the requirements of the state economic plan and the environmental protection plan be closely coordinated.

5. Environmental Protection Projects in the State Plan Should Be Treated as Indicators for Economic Review

Inclusion of environmental protection projects in the national economic plan is just the beginning: organizational measures are even more important. This work has not been done well in the past. It generally happens that in the process of implementing plans, certain departments and units have had insufficient manpower and material resources, and accordingly they have only

followed the production assignments and have ignored the environmental protection assignments. This is because the production assignments included review indicators, and if they were not accomplished the organizations would be subject to economic or administrative sanctions, while failure to accomplish the environmental protection assignments entailed no such sanctions. Although this situation has been somewhat improved in recent years, the problem still exists. In order to assure that planning assignments for environmental protection are actually carried out, they must have the force of law just as the production plan does, and accomplishment of environmental protection plans should be part of the state review of the localities, departments and units. Those who have accomplished them well should be rewarded, and those who have not should be subject to economic or administrative measures. The economic departments and People's Government at all levels should review not only production but environmental protection work, and any problems discovered should be quickly solved. The basic-level units should make their environmental protection tasks into targets serving for review of their shops and shifts. Only in this way will it be possible to make environmental protection develop steadily and soundly as the national economy develops.

8480
CSO: 5000/4015

RELATIONSHIP BETWEEN ENVIRONMENTAL PROTECTION, ENTERPRISE RENOVATION DISCUSSED

Beijing HUANJING BAOHU [ENVIRONMENTAL PROTECTION] in Chinese No 1, 1982
pp 1-2, 21

[Article by Sun Jiamian [1327 0857 4875]: "Environmental Protection Must Be Closely Coordinated With Enterprise Technical Renovation"]

[Text] An effort in enterprise technical renovation and equipment modernization aimed at saving energy, improving product quality, decreasing materials consumption and increasing the number of varieties and colors is proceeding in planned, systematic fashion in a multitude of enterprises throughout the country. This is extremely beneficial to environmental protection work in industrial and communications enterprises. The environmental protection departments and the enterprises and their cognizant departments must implement the spirit of the Fourth Session of the Fifth National People's Congress, carry out the relevant directives of the party Central Committee and the State Council regarding environmental protection, act in close coordination and cooperation, and use the technical renovation and equipment modernization of industry to raise environmental protection work to a new level.

1. In recent years our country's environmental management work has been greatly strengthened, and environmental protection work has achieved good results. There has been some mitigation of environmental pollution in cities such as Lanzhou and Shenyang, water quality has improved somewhat in such water bodies as the Bohai, the Yellow Sea, the Guanting Reservoir, and West Lake in Hangzhou, and the quantities of such toxic or harmful substances as phenol, cyanide, chromium, cadmium, mercury and arsenic in some industrial and mining areas have decreased considerably. According to incomplete statistics, the quantity of waste discharged per 10,000 yuan of gross industrial output decreased by 8 percent from 1979 to 1980, the average wastewater treatment rate for 1980 was 8.2 percent, and the solid waste recovery rate reached 19.6 percent.

But because the principle of the "three simultaneous activities" in new construction projects has not been well implemented, because older enterprises have been making slow progress in pollution control, because enterprise productive capacity has been expanding continuously, and because neighborhood and commune industries have been developing rapidly, there has been a

continuing increase in new pollution sources, and pollution is spreading and becoming more serious. In 1980 the total amount of wastewater discharged nationwide increased by 9.7 percent from the 1979 level, a rate of increase which was faster than the 8.7 percent growth of industrial output. The quantity of wastewater discharged annually which did not meet discharge standards reached 26 billion tons. There has been strong public reaction to the negative effects of pollution, and disputes between industry and agriculture over pollution are increasing in number. Many cities' drinking water supplies are seriously polluted, subsurface water tables are falling to a considerable degree, and in a few localities there has been serious surface subsidence. Extensive areas are drought-stricken or short on water and also suffer pollution, resulting in a water resource crisis. Environmental pollution has become a major problem of our economic and social development.

2. Solving our environmental pollution problems, particularly those of industrial enterprises located in densely populated urban areas, drinking water protection areas, and cultural, historical, scenic and tourist areas, must be closely linked with technical renovation and equipment modernization.

First, the pollution problem is objectively determined by social progress, economic development and industrial expansion. On the one hand, many countries are treating the problems of environment, population, resources and development in integrated fashion and studying the relationship between development and the ability of resources to support it; on the other hand, taking effective steps to stop the destructive development of resources and their shockingly wasteful utilization requires that people make use of advanced science and technology and carry on efficient industrial equipment, increase the utilization rate of resources and create more wealth and a more suitable living environment for man. Accordingly, the efficiency and optimality of resource and energy utilization and the quality of the environment have become important standards for determining the level of a country's economic development and its ability to remake and utilize nature.

It is impossible for industrial production to make complete use of resources and energy without producing any waste, but the use of advanced scientific and technical methods to gradually raise resource use efficiency both can and should be achieved. The fact that increasing the resource utilization rate, elimination of environmental pollution, technical renovation and equipment modernization are mutually supporting, mutually limiting components in the organic unity of the national economy stems from the inevitable course of economic development.

Second, environmental pollution is actually waste of resources. The wastes discharged during industrial production result from incomplete utilization of materials and energy during the production process. We know that every year the country's key nonferrous metals enterprises discharge 170,000 tons of dust containing copper, lead, cadmium, mercury and arsenic and the like and 500,000 tons of concentrated sulfur dioxide into the environment annually and that 49 large and medium-sized cement plants nationwide discharge 1.5 million tons of cement dust a year over and above the 1 million tons which is recovered. If the metallurgical enterprises could recover and utilize 50 to 60 percent of this waste and the cement plants could recover a million tons of the dust, what

a quantity of material and energy they would save, and what an economic and environmental result they would produce! In addition, the Northeast, North China and East China have serious energy shortages. If a certain area which has 52 power plants with a total of 1.93 million kW of installed capacity and an annual coal consumption of 9.69 million tons were to replace obsolete equipment with large high-temperature high-pressure generating units, while using the same amount of coal its capacity could reach 3.17 million kW and its electrical output would increase by 64 percent; how much energy this would save the country, and what a decrease in smoke, flyash and sulfur dioxide pollution it would produce compared with the construction of 1.24 million kW worth of new power station capacity! There are many more examples of this type of waste and pollution.

Third, since pollution occurs during the production process, pollution prevention should also be carried on during the production process. The reason that many enterprises have low resource utilization rates and serious pollution, other than management-related causes, is directly connected with obsolete technologies, outmoded process equipment and inadequate facilities. Accordingly controlling industrial pollution must be connected with the technical renovation and equipment modernization of all enterprise production stages if it is to be truly effective.

The Shenyang Metallurgical Plant's great production advances and outstanding pollution control achievements associated with technical renovation are a laudable example. This plant is more than 40 years old, its equipment was obsolete and its processes outmoded, and it produced serious pollution and great harm, but it carried out technical renovation and solved its problems by treating the expansion of production, efficient resource utilization and the pollution problem as a unified whole. After 3 years' effort it succeeded in recovering large quantities of pollutants that would have been discharged into the atmosphere; it now recovers 113,000 tons of sulfuric acid and 1,000 tons of metals such as copper, lead, cadmium and mercury and saves 66 million tons of water, 11,000 tons of coal and large quantities of other materials each year. Its actions caused a marked decrease in the quantities of sulfur dioxide and metal dust in the air of Shenyang City and a considerable decrease in the quantities of heavy metals in wastewater and of toxic substances in solid waste, while in the past 3 years the plant's average gross output value has increased by 7 percent a year and its profits by an average of 30 percent a year. Thus it has achieved outstanding economic, social, labor protection and environmental results. Industrial production is booming and the entire populace of the city and all of its employees are happy.

Fourth, controlling industrial pollution and protecting the environment are a prerequisite for building an advanced social-material and spiritual culture. We are a socialist country, and our aim in production is to satisfy the increasing material and cultural needs of the broad masses of the people while improving their living environment and level of health.

This requires that enterprises use modern scientific and technical methods and do everything possible to adopt new processes and new equipment. In addition they must give due attention to inexpensive, effective small improvements, improve resource utilization rates, protect against pollution, and

gradually achieve plants which produce no harmful substances and are clean and well run. The question of whether an enterprise (particularly an urban enterprise) can improve its environmental protection work in the course of this technical renovation will determine whether it can achieve maximum economic results, whether it can remain in production for a long period, and whether it can carry out production modernization.

3. In technical renovation and equipment modernization, the key to effective industrial pollution prevention and control is strong leadership, adequate understanding and appreciation of the problem, and the taking of effective steps.

First, there must be practicable general and specific plans. In the general plan for technical renovation and equipment modernization, the environmental protection departments and the enterprise and its cognizant departments must specify each unit's overall orientation and specific tasks in pollution control. Because pollution is a serious problem whose treatment has been long deferred and because financial and material capabilities are limited, it cannot be solved in a short period; following thorough investigation and substantiation, priorities must be assigned and the tasks carried out stage by stage. The emphasis should be laid on urban industrial centers and key enterprises, and problems which involve large-scale waste of resources and energy, serious pollution and sharp conflicts with surrounding inhabitants or the peasants should be scheduled for solution first. Because technical renovation and equipment modernization are a long-term undertaking, the environmental protection departments must treat them as an important, continuing activity, must give overall consideration to pollution control work in their areas or departments, and must include their completed general plan and specific requirements in the plans issued by planning departments and other relevant departments.

Second, environmental protection management work must be strengthened, and various measures, including economic, legal, administrative and propaganda and education measures, must be adopted in order to promote pollution control work as part of technical renovation. Pollution fines should be levied against units which have pollutant discharges in excess of state standards, and effective awards should be instituted for products which make comprehensive use of wastes. Enterprise environmental management must be combined with production and technical management, and various types of environmental management systems, pollution control targets and systems of rewards and penalties based primarily on the responsibility system must be developed and made to function effectively. Effective operation and management of existing environmental equipment and improvement of its completeness, operating time, treatment effectiveness and availability will assure that pollutant discharges meet plan requirements.

Third, all enterprise potential must be utilized and the necessary funds must be raised. Saving energy and raw and other materials, improving product breakdowns, making rational use of resources and improving enterprise economic results are the main objectives of technical renovation, and they imply control of pollution. In cases where such projects are hard to separate from

other, some units practice unified planning and utilization of the funds they can mobilize, achieving rather good economic results; in other cases environmental protection projects can be handled as separate entities. In present-day circumstances there are numerous funds channels; these include modernization and renovation funds under enterprise control, profits retained by enterprises which form part of the enterprise production fund, profits retained according to regulations for comprehensive utilization of wastes, returned portions of pollution fines and the like. In addition, larger projects can be treated as capital construction projects, projects involving renovation of inefficient processes can be treated as technical projects, some equipment alterations can be dealt with in connection with major overhauls, and in cases where comprehensive utilization will increase profits and there is the capability for repayment, small loans may be sought from banks.

Fourth, leadership must be intensified and the spirit of the relevant State Council documents must be completely implemented. Environmental protection is highly interrelated with a wide range of other activities. The environmental protection departments must work in close coordination with various other departments and entities, strengthen their cooperation, approach pollution control and economic development as being aspects of the same undertaking, and think in overall terms; they must aid pollution control units, furnish technical information, promote pollution-free or low-pollution industrial equipment and processes, and help with monitoring; and they must summarize, exchange experience and disseminate and propagandize good experience with comprehensive utilization and pollution control obtained in the process of technical renovation. They must monitor progress at regular intervals, make timely reports to higher-level offices, take it upon themselves to secure party and government leadership and support, stir up an energetic spirit, and take realistic steps to assure that environmental protection work in 1982 will achieve even greater results.

8480
CSO: 5000/4025

ECONOMIC ASPECTS OF ENVIRONMENTAL PROBLEMS DISCUSSED

Changchun JILIN DAXUE [JILIN UNIVERSITY JOURNAL] in Chinese No 2, 1982 pp 20-27

[Article by Du Xianren [2659 2009 0088]: "Economic Investigation of Environmental Problems"]

[Text] The natural environment is the space in which man exists. We may say that the environment is a condition for human production and creation and that man is able to develop through changes in the environment. Every stage, from that of cave dwellers and nomads to today's modern production and culture, reflects man's progress in adapting to, utilizing and remaking the environment. Although nature is independent of and external to human society and has its own physical cycles and laws of energy conversion, once human social and economic activity become involved in the material movement of nature, environmental questions cease to be simply questions of such natural sciences of environmental chemistry, environmental biology and environmental geoscience, and become questions of social economics as well; economics has begun to enter environmental science.

This paper attempts to elucidate the interrelationship between environment and economics in terms of society's dependence on the environment, the effects of social reproduction on the environment, and economic questions of environmental protection.

A. Human Society's Dependence on the Environment

1. The Environment Is the Space in Which Man Lives

Environmental questions have existed as long as man has. We know that long before man appeared the environment had undergone a long development, but before man existed there were no such thing as environmental problems. The term "environment" refers to the objective conditions for some central thing. The center of the natural environment should be man, because man is the master of the natural environment and the natural environment is the space in which man lives.

Nature is spatially unlimited, but the natural environment which is suited to man's existence is limited. Thus far, man and other living things have lived primarily on the surface of the earth. We generally refer to the surface of

the earth which is suitable for the existence of man and other living things as the "biosphere." The biosphere as it is currently recognizable lies generally between the limits of 11 kilometers below sea level (the deepest part of the Pacific Ocean) and 90 kilometers above sea level (the troposphere and part of the stratosphere). The environment within these limits forms the main arena of vital activity and the space in which man exists.

The biosphere consists of the atmosphere, water, rock, soil and all things which live in them. The natural environment is the sum total of all of these factors surrounding man.

The atmosphere consists of oxygen, nitrogen, rare gases and the ozone of the upper atmosphere, with an admixture of water vapor and carbon dioxide. The oxygen and nitrogen which it contains are elements essential for life. This atmosphere, which has evolved over many eons, is important for the respiration of living things.

It not only provides elements essential to man, but also protects living things on the earth against harm from various types of rays from outer space, protects water vapor on the surface of the earth from being lost, and regulates temperatures. Accordingly the atmosphere is an essential environment for the existence of man and all living things.

Water accounts for about 70 percent of the surface of the earth. Water evaporates from the surface of the earth into the atmosphere, condenses as rain or snow and falls back to earth, thus forming the hydrologic cycle in nature and providing the water needed by living things. Water is essential to living things; 70 percent of the weight of the human body and 83 percent of blood is water. Moreover, the transport of nutrients in living things, the elimination of metabolic wastes and the heat balance of the body all depend on water. An adult human needs at least 3 liters of water a day. If the human body is deficient in water by an amount equivalent to 20 percent of the body weight, life is endangered. Clearly water is an essential environmental factor for man and other living things.

Rock and soil are the base on which living things grow. Surface rocks have produced soil through long weathering, erosion and biological activity. Other than hydrogen, oxygen, nitrogen and carbon, which can also be obtained from air and water, the chemical substances on which life is based all come from rocks and the soil. Soil is the medium in which plants grow; plants absorb minerals and water from it, grow using sunlight for photosynthesis, and provide abundant food for man and other animals. Obviously, soil is also an environmental factor essential to life.

To summarize, living things can only live in an environment with sunlight, air, water and soil, so that these form the natural basis for the life of man and all other living things. When we say that the natural environment is the space in which man lives, this is first of all because the natural environment is the area from which man obtains his basic vital materials.

2. The Natural Environment Is an Essential Condition for Social Material Production

The natural environment not only is the area from which man obtains his basic life materials, but a constant natural condition for human society's material production. The natural environment consists of matter, and accordingly, as natural resources, it forms an essential material factor for social production. Natural resources can be divided into three categories:

a. Ecological resources such as sunlight, air and water. In ancient times these miraculous things were considered the basis of all living things; they are inexhaustible resources which man can use freely and are called "permanent resources."

b. Biological resources such as forests, grasslands, aquatic life, birds, animals, microorganisms and soil. These resources can renew themselves, and if suitably used and more effectively nurtured they can be made inexhaustible; accordingly they are called "renewable resources."

c. Mineral resources such as coal, oil, minerals and the like. These resources were formed over eons of geological development and are limited in quantity, so that they are "nonrenewable resources."

The natural resources described above form the basis of man's existence and material production and are constant, eternal necessities for the productive activity of human society.

The utilization of natural resources is not permanently fixed. As the level of the productive forces rises and man's ability to utilize and remake nature is strengthened, the content of use of natural resources will expand continually. While in the initial period of human society people derived finished material resources directly from the natural environment to a greater degree, as science and technology develop, people will be increasingly able to utilize natural resources that were formerly unusable or essentially unknown. Sunlight was originally the medium with which plants carried out photosynthesis, but now it has become the most promising energy resource for production. People often conceive of bacteria as harmful, but they can help people in industrial production and can be used in metal beneficiation and pharmaceutical production. In other words, as man gains a deeper knowledge of nature, he develops new materials and produces a myriad of composite and synthetic materials, but all of this stems from the material environment. The dependence of human social production and economic activity on the natural environment will never end.

Social production's dependence on the environment is not abstract; the natural environment is a specific geographical environment. On this planet of ours, natural environments differ in thousands of ways and have distinct regional characteristics. Even within a small land area, soil conditions, hydrogeology and mineral distribution may vary greatly. It goes without saying that geographical environment has a great influence on the economic development of a country or region.

First, nature like labor, is a source of utility value, because material wealth ultimately consists of utility value. In economic terms, natural wealth can be divided into two categories: means of livelihood such as the fertility of the soil and the abundant fish in the waters, and means of labor such as water power, forests, metals, petroleum and the like. In general, in the initial period of human culture, the means of livelihood had a major effect on social and economic development, when man had developed to a relatively high level, the means of labor came to have an increasingly greater effect. Particularly under current world conditions, the rapid growth of production and consumption have already made some resources into scarce strategic materials. Possessing abundant natural resources may bring immense social wealth to a country. For example, the Organization of Petroleum Exporting Countries [OPEC] is now fully aware of world demand for its scarce product, and accordingly the prices which it sets for petroleum may be more than 10 times its production cost.

Second, the geographical environment may affect the distribution and development of production sectors. Agriculture may develop faster on fertile land, while livestock raising can only flourish on land suited for grazing; without minerals and fuel resources it is difficult to establish extractive industries. We frequently speak of developing production "in accordance with local conditions"; this means primarily setting objectives which are suited to differences in natural environments. The objective in development of social production is correct handling of the interrelationship between three factors requirements, capabilities (technical and financial) and resources. Natural resources will always be the starting point and precondition for our long-term development plans.

Third, the geographical environment can hinder or aid our production of material goods. This is because the natural conditions for labor differ and can cause different economic results to be achieved from investments of the same size. For example, because ores are of different quality, deposits occur at different depths and transport distances differ, supplementary investments in mine development and production costs differ considerably. To be sure, man can remake the natural environment and a country can use indirect methods to obtain natural resources (such as importing raw materials). But a well-endowed geographical environment has a great effect on social and economic development.

Economic Analysis of Social Production's Effect on the Environment

Society's economic activity begins with production. So long as there is human productive activity, there will be interchange of matter between man and the environment and consumption of environmental resources, and the natural environment will be affected and remade concurrently with productive activity.

a. The Process of Interchange of Matter Between Man and the Environment

As we said above, we use the term "environment" with reference to man, because it implies the relationship between man and nature. For man, the environment is the material world which interchanges matter with him and with human society.

We may say that in the final analysis the relationship between man and nature is one of interchange of matter.

Matter interchange between man and the natural environment is different from interchange of social products. Modern-day exchange of social products is based on commodity production. Commodities are things which on one hand have utility value and can satisfy people's needs, while on the other hand they have exchange value and can be exchanged for other goods. In the exchange process, commodities are transferred from holders for whom they lack utility value to those for whom they do have utility value in accordance with the principle of equal value.

But in the case of material interchange between society and the environment, on the one hand all materials which social production and daily life require are obtained from the environment, while on the other hand all waste materials from production and daily life are returned to the environment, forming the process of interchange of matter between man and nature.

Thus the characteristics of matter interchange between man and the natural environment are that environmental resources have utility value and accordingly are exchanged with man, while "products" which can be exchanged for them by man are generally wastes which harm the environment. If we call man's exploitation and utilization of the environmental resources "positive exchange" of environmental material, then the discharge of waste products into the environment following consumption by human social production and daily life can be called "negative exchange." Obviously without the first type of exchange the second is impossible. This is because matter is conservative and, with the exception of atomic decay, all atoms which enter the human economic system will be discharged by it in different combinations. Thus this cyclic character in material interchange between mankind and nature results in an interconnection between the economic reproduction process in human society and energy interchange and the material cycles in nature. Once there is material interchange between man and nature, man unavoidably has an effect on the natural environment.

Another characteristic of matter interchange between man and nature is that environmental resources are natural products, not products of human labor: they have utility value but not [intrinsic] value. Thus material exchange between man and the environment is not commodity value interchange, and accordingly it cannot have guardians and protectors as in the case of commodities. Instead, it consists of man's uncompensated taking from the natural world. The environment is both a natural treasurehouse from which man may take at will and a garbage heap into which he may discard what he wishes: man can take possession of it, plunder it and damage it. But nature's patience is limited; when the exchange of matter between mankind and nature harms the normal balance of the ecology, nature will retaliate against man. Engels cited the following examples. We should not be excessively self-congratulatory over our conquests of nature. For each such conquest nature repays us. In order to obtain farmland, the inhabitants of Mesopotamia, Greece, Asia Minor and other lands cut down the forests, but they did not dream that these places would today be barren wastelands and that when they

stripped the land of its forests it lost the factor that was critical for accumulating and storing moisture. The Italians cut down on the southern slopes of the Alps the pine forests which were carefully protected on the northern slopes without realizing that they were destroying the basis for their high-pasture livestock raising; even less did they realize that this would cause the springs to dry up for a large part of the year and that during the rainy seasons even fiercer torrents would pour down to the plains. These examples make it clear that this retaliatory aspect of nature usually results precisely because man has abused the environment rather than protecting it.

The above analysis makes it clear that the interchange of matter between man and the environment affects the environment in two ways. On one hand, all of the material which man needs is taken from the environment, while on the other all wastes produced by human society's economic activity are returned to the environment: this is the most basic material relationship between man and the natural environment. But matter exchange between man and the environment also must conform to the laws of the natural environment's matter cycle and energy flow, and accordingly man does not stand outside nature. Man is not primarily social man but natural man; even our bodies belong to nature and exist in nature. Any harm which man does to the environment is unquestionably harmful to mankind.

b. Consumption of Environmental Resources

In analyzing the exchange of matter between man and the environment, we have left aside the question of consumption of natural resources. In reality the exchange of matter between man and nature is possible only through the process of consumption of environmental resources by human society. This is because the basic aims of matter exchange between man and the environment are production and consumption, and only through productive consumption and consumption in daily life can society's waste products be returned to the environment, producing interchange of matter between man and the environment.

In this context, the material relationship between man and the environment is that man takes in material resources from nature, passes them through the social production and consumption system and discharges waste products, returning them to nature. Thus social production and consumption are the intermediaries in matter interchange between man and nature and are the origin of environmental problems. While consumption exists there will be a process of matter interchange between man and society, and environmental problems will arise.

But before the advent of large-scale mechanical industry, because the productive forces were not highly developed, society's ability to influence the environment was very limited. It was only when science and technology progressed, society and economics developed and the human population burgeoned, resulting in a sharp increase in consumption, that environmental problems became major social problems attracting serious concern.

We said before that nature was an inexhaustible treasurehouse from which man could take, but now the amount of things that man can take at will is steadily

decreasing, and only sunlight and air are still free for the taking--and in some locations air pollution is threatening health.

The world has extremely plentiful fresh water resources, but water shortages are developing in many cities. In particular, the water requirements of certain cities with large concentrations of industry and population already exceed the limits of natural resources, subsurface water is exhausted, resulting in surface subsidence, and the water is becoming polluted, which is gravely affecting the inhabitants' lives and the expansion of production.

Forests and grasslands are essentially renewable resources. But because of extensive cutting of forests for wood, the conversion of forests and grasslands to farmlands, and overgrazing, the percentage of plant cover in them is decreasing, which has disrupted the ecological balance, in some places producing soil erosion, alteration of climate, and desertification and salinization of grasslands, so that renewable resource lands become denuded hills which cannot be restored naturally.

Nature's mineral resources are also extremely plentiful. But man has consumed and wasted them in a shocking manner. Consider fuel resources, for example; world consumption of petroleum and natural gas doubles every 9 years, so that petroleum has already become a scarce resource. Waste of minerals manifests itself in loss of resources: it is estimated that of currently developed world mineral resources, as much as 50 percent is wasted, producing large quantities of solid, liquid and gaseous waste and seriously polluting the environment.

All of the above makes it clear that pollution of the environment and disruption of the ecological balance result from a high level of industrial and agricultural development and from a rapid increase in consumption. In specific terms, environmental questions develop into the following four main kinds of social harm.

1. Environmental harm produced when highly developed industry and agriculture consume large amounts of resources and the wastes which they produce (solid, liquid and gaseous) are discharged at will, causing environmental harm. According to some estimates, worldwide wastes include discharge of 3 billion tons of solid waste, 500 cubic kilometers of liquid waste and 600 million tons of gaseous waste.

2. Environmental harm caused by high concentrations of population, increased amounts of living wastes, and failure to utilize or treat these wastes, which are discharged at will into the environment. Examples are pollutants such as trash, wastewater and motor vehicle emissions.

3. Environmental harm produced when development and use of resources exceeds resource renewability. Examples are excess withdrawal of subsurface water, wanton cutting of forests, uncontrolled taking of wild animals, excess taking of aquatic products, intensified use of soil and grasslands, irrational large-scale hydraulic engineering projects, reclamation of land from lakes, opening up of grasslands to cultivation and the like, all of which disrupt the ecological balance and damage natural resources.

4. Environmental harm caused by irrational geographical distribution of production so that pollutants discharged into the environment are overconcentrated and exceed the environment's natural self-purification capabilities.

The analysis above treats two ideas. One is that as soon as production and consumption by human society exist, there is exchange of matter between man and nature and environmental problems arise. The second is that under current scientific and technical conditions environmental pollution and damage can be limited and possibly prevented, and that provided we use natural laws correctly and effectively strengthen environmental protection, man can become the true master of the natural world.

c. The Social Production Process and Alteration of the Environment

We begin by investigating the social production process as a process by which man produces material goods in general.

The process of producing society's material goods is a labor process by which man changes the material form of nature through purposeful activity so that it can satisfy certain needs of his. If any society ceases production of material goods, the people will be unable to continue living and will die within a short time. Accordingly, production of material goods is the foundation of human social life and of society's existence and development.

We now consider man's production process as a process of conquering nature and changing his living environment.

The process of man's production of material goods is also a process in which he utilizes and purposefully alters nature. Unlike animals, which can influence nature only by their existence and adapt their bodies to nature, man primarily uses his labor to alter the environment and change it into a new living environment. The environment in which man lives today has long since ceased to be a simple natural environment; it is an environment reworked by man.

The purpose of production of material goods is to satisfy man's requirements for utility value, of course including the reworked natural environment. But its utility value as a product is distinct from its utility value as a natural environment. For example, a motor vehicle can be bought as a commodity, but if a location lacks roads to drive on and an automobile that one possesses cannot be used, an environmental problem arises. Accordingly, as environmental material, roads satisfy people's needs in a different utility-value form. Again, if a reservoir is built, it can serve as an environmental rsource and can be used for irrigation or for raising aquatic products, while at the same time it is also a material environment for daily life and is used to regulate the climate and as a scenic attraction. Furthermore, in addition to satisfying people's spiritual and cultural needs, parks and historic landmarks are also economic products which increase tourist income. Thus the content of the manmade material environment is also extremely rich, and it has a multitude of uses.

Above we said that the process by which mankind produces material goods is also a process in which man purposefully modifies the environment. It is a pity that as social production develops, production waste discharges increase rapidly, so that conversely, the process of man's production of material goods also becomes a process of continual degradation of the environment. Many environmental problems not only produce serious harm for present-day man, but may also have far-reaching consequences for future generations. On the one hand, man's social production improves his living environment, while on the other it also degrades it; this dual effect on the environment reflects both the results of the development of human production and of scientific and technology and the results of their failure to develop. The fact that "progress brings about harm" has non-progress implicit in it has compelled man to reach a new understanding of his social production problems, which has led to the birth of environmental science as an integrated scientific discipline.

To summarize, social production has a major effect on the natural environment. On one hand, man continually improves his living environment, while on the other, he degrades it; this is the law of union of opposites with regard to development of social production and of environmental problems. This is in fact a major problem which inevitably arises in the modernization process and which must be suitably solved.

Economic Problems of Environmental Protection

a. Should Protecting the Environment, Improving the Environment and Creating an Excellent, Suitable Environment Be an Objective of Socialist Economic Development?

The basic economic laws of socialism embody the fact that social production is intended to satisfy people's continually increasing material and cultural needs. What are people's material needs? Everyone will easily recall the basic necessities of life, i.e. food and clothing; but people generally forget that above all, man and animals cannot be parted from the four basic environmental factors of sun, air, water and soil. As a natural man, in addition to obtaining his food every day, man also needs to drink about 3 liters of water and to breathe about 10,000 liters of air: these are essential materials for life. If there were no environmental pollution and no disruption of the ecological balance, man could enjoy the natural products air and water to his heart's content. But he now must expend labor to make the air fresh and to purify polluted water. Accordingly, protecting his living environment has already become part of production activity and an objective of economic development.

As society and the economy develop and man's basic needs of food and clothing are satisfied to a certain extent, his need to improve his living environment becomes even more pressing. We frequently hear people who are eager to improve their living environment, who complain about dusty roads in fair weather and muddy roads in wet weather, and who hate dusty, foul-smelling working environments; all of these attitudes reflect man's need to improve his environment. We frequently say that it is hard to obtain food, housing, clothing and transportaton in the cities: In addition to production factors,

these problems are also due in large part to the facilities of the urban environment, for example, housing facilities, transportation facilities, health facilities, cultural facilities, work facilities and parks and green areas. The so-called man-made urban environment consists primarily of these nonproductive facilities. Accordingly, to continually increase investments in urban public services and build an excellent, suitable environment naturally should be a goal of socialist economic development.

2. Is "Pollution First, Treatment Afterward" the Universal Law of All Social and Economic Development?

Since the revolution in production, modern industry and communications have developed rapidly. In some developed capitalist countries, environmental pollution has long been a social menace. It was only the world-shaking occurrence of the London fog incident and the three major pollution diseases in Japan (respiratory disease, "bone-ache disease" and Minamata disease) in the 1950's that stimulated the struggle against environmental pollution by the people of all countries. Against this social and historical background, in the 1960's governments set up environmental protection organizations one after another, issued environmental protection laws, increased investments in pollution control and set up special environmental protection research organizations. After 20 years' active effort in dealing with the problem, environmental protection has achieved outstanding results in some countries. This is the route of "pollution first, treatment afterwards" that some countries have taken.

The situation of "pollution first, treatment afterwards" is actually a product of the capitalist system. Capitalist production, which seeks maximum profits, naturally cannot concern itself with the public interests of the masses. Without the struggle of the masses, without the coercive force of society, the capitalists would not willingly engage in pollution prevention. "Pollution first, treatment afterwards," which is a reflection of the intrinsic characteristics of the capitalist economic system, is a logical, inevitable law.

The socialist economic system is based on public ownership of the means of production, and all of its productive activity is carried out in the public interest and in the interests of the people. The environmental protection policy of "protect the environment and create benefits for the people" laid down by the party and state is a concrete embodiment of the principle of "everything for the people" and reflects the superiority of the socialist economic system.

But the superiority of the socialist economic system is not realized automatically. Thirty years' experience shows that in the past our several hundred thousand industrial and communications enterprises failed to carry out environmental protection measures, so that our country's environmental problems became extremely pressing. This situation had many causes, such as inadequate understanding, technical and economic conditions, and in particular the interference and sabotage of the "gang of four." But the basic reason was that the guiding ideology of "production for production's sake" persisted for a long period in our economic work.

When the focus of the whole party's work shifted to socialist modernization the national economy began to carry out readjustment, reform, reorganization, and upgrading, and in 1979 the first "(Provisional) People's Republic of China Environmental Protection Law" was issued. This marked a new historical stage in our country's environmental protection work.

Many instances, domestic and foreign, demonstrate that producing pollution is easy and dealing with it is difficult. Once the environment is polluted, even if new pollution is stopped, a long period is required in order to eliminate the old pollution, and it may be very difficult to restore the initial situation. It is worth particular notice that environmental pollution may even produce secondary pollution. For example, because hydrocarbons and their compounds discharged into the atmosphere undergo photochemical reactions under the influence of sunlight and produce many strong oxidizers, primarily ozone, secondary atmospheric pollution has arisen. Secondary pollution may also result from water pollution. The Minamata disease which attracted worldwide attention was a grave instance of the conversion of inorganic mercury into highly poisonous methylmercury.

To summarize, our back debt in environmental pollution must be paid up, and the longer we delay, the greater the cost that must be paid. At the beginning of the four modernizations, we must devote attention to producing no more pollution or at least to minimizing new pollution and must strive to achieve outstanding results in environmental protection is not too long a period.

c. The Effect of Environmental Protection Investment on Economic Development

In order to assure that we achieve environmental standards suited to human life and avoid disruption of the natural ecological balance, we must make new additional investments in productive construction and handle these expenditures as enterprise production expenditures, which will have a major effect on economic development.

First, the costs of environmental protection equipment are major expenditures. In Japan, for example, pollution control equipment investments in large and medium-size enterprises in 1970 accounted for 5.8 percent of total corporate investment, while in 1975 the figure had increased to 17.7 percent. In 1976 several major branches of industry devoted the following proportion of total investments to pollution control facilities: 20.6 percent in the iron and steel industry, 18.4 percent in the petroleum industry, 43.8 percent in the fossil-fired electric power industry, 17.5 percent in the paper industry, and 18.5 percent in the chemical industry.

In this country, because most enterprises built in the past took no steps for control of pollutants, we incurred a great back debt. It is estimated that the adoption of environmental protection measures in over 1,000 large and medium-size enterprises which are serious polluters will cost about 30 billion yuan. According to Shanghai City's preliminary plan, pollution control expenditures will be 4 to 5 billion yuan. It will be difficult for the country to lay out such a sum in a short period, and our only recourse is gradually to increase our environmental protection investments as the economy develops.

Second, environmental protection investments generally do not constitute productive forces, so that the rate of economic growth is likely to be affected for a rather long period. Although investments in environmental protection equipment may lead to development of the environmental protection equipment industry and promote the improvement of environmental technology, experience makes it clear that large environmental protection expenditures will still constrain economic growth.

Third, environmental protection investments are certain to increase enterprise investment costs, raise production costs and depress enterprise profits, or even lead to rising commodity prices.

Environmental protection costs will unquestionably affect the rate of social and economic development. The problem is that the rate of economic growth is not our fundamental objective: the objective of production is to satisfy social needs. The speed which require is that which assures satisfaction of the people's needs. At the same time, we must also be aware that preventing environmental pollution may also yield benefits for the economy. For example, treating smokestack emissions may decrease agricultural crop losses; treating water pollution can protect the development of aquatic life, and, even more importantly, will decrease disease in humans and relieve people's spiritual suffering, which will have major long-term effects on economic development.

4. The Relationship Between Enterprise Economic Effectiveness and Social Economic Ineffectiveness in Environmental Problems

Economic effectiveness is a synonym for economic results. Any economic activity involves the question of cost versus gain, i.e. economic results. The economic result of production consists of the relationship between the labor and means of production expended and the social product obtained. In simple terms, it is the relationship between expenditure and usefulness.

There are many indicators of the economic results of enterprise production, such as output volume, output value, production cost, funds, profit and the like. If an enterprise has large output volume, low production cost and high profits, we say that its economic effectiveness is good; otherwise we say its economic effectiveness is poor.

The main key to enterprise economic effectiveness is whether the usefulness obtained from the product recompenses production outlays; it generally takes no account of the economic effectiveness of the national economy. This emerges particularly clearly in the matters of development and use of environmental resources and environmental pollution.

For example, in mineral extraction, it is generally desired to extract the rich ore or relatively easily exploited minerals in a given district and to discard low-grade or hard-to-extract ore. Using methods which waste natural resources increases enterprise economic results. From the enterprise's point of view it is economically effective, but from the point of view of society it is economically ineffective.

Again, a factory in Guilin completes its production plan every year and pays large amounts of profits to the higher levels; but because it has no pollution control, it has polluted the Li Jiang. In terms of enterprise economic effectiveness this is a good plant, but in overall terms it is economically ineffective for society. When a plant ruins a river its merits cannot outweigh its faults. Who knows what it costs to cure the pollution of a river?

Thus our economic workers must look at matters not only in terms of developing production, but also in terms of protecting our natural resources and protecting the ecology. They must consider not only an enterprise's economic effectiveness, but the economic results of production activity for all of society.

8480
CSO: 5000/4033

ECONOMIC, ENVIRONMENTAL IMPACT OF RESERVOIRS ON RIVER SYSTEMS

Beijing SHUILI SHUIDIAN JISHU [WATER CONSERVATION AND HYDROELECTRIC POWER TECHNOLOGY] in Chinese, No 3, 20 Mar 82, pp 55-59

[Article by Zhang Chun [1728 4783] of the Beijing Surveying and Design Academy of the Ministry of Water Conservancy: "The Impact of Reservoirs on the Environment"]

[Text] Since Liberaton, China has built more than 86,000 large, medium and small reservoirs, including more than 2,600 large and medium ones. These reservoirs serve flood prevention, irrigation, generation of electricity, navigation, fish culture and supply water to cities and industries. But some reservoirs have also brought about an unfavorable impact on the environment. This has gradually been recognized and emphasized and measures have been taken for some of the reservoirs, where the unfavorable impact has been eliminated or reduced, but some problems still have not been recognized. As water conservancy workers, we must clearly understand the impact that reservoirs have on the environment in planning, designing, using and managing reservoirs. We must see the beneficial side of reservoirs and we must also see the unfavorable impact on the balance of nature brought about by the building of reservoirs. The experience of building water conservancy projects has made us realize that they should be economically rational and technically advanced, and environmental problems must also be considered. The beneficial impact of a reservoir on the environment is described in detail in the plans and designs of that reservoir. But to better consider environmental problems of reservoirs, this article will emphasize the unfavorable impact of reservoirs on the environment. Because our nation is so large, the geographic locations of reservoirs are different, and their unfavorable effects are not all the same. Therefore, the problems mentioned in this article are only presented as reference.

I. The Impact of Reservoirs on Natural Environment

(1) Silting in Reservoirs

If a reservoir is built on a river with a lot of mud and sand, a large amount of mud and sand will become silt in the reservoir. When silting in the reservoir is serious, loss due to backwater increases and the useful capacity of the reservoir is reduced. The level of flood prevention is lowered and the

usefulness of the reservoir is lessened. The best way to solve the problem of silting is to gradually put in conservancy projects for water and soil in the upstream river valleys of the reservoirs. This is the basic way to control sand.

(2) Erosion or Changes in Flood Discharge in Downstream River Channels

Certain reservoirs discharge clean water because the stored body of water blocks the sand and the conditions of the water and sand of the original river channels are changed. Erosion or a change in the flood discharge in the downstream river channels occurs. The section of the Yellow River below the Sanmenxia Reservoir washed away 2.3 billion tons of mud and sand from September 1960 to October 1964. Clean water washes away mud and sand for a longer distance. During the erosion period, the flow of water in the river segment from Tiexie to Reiguhe in Henan Province is characterized mainly by downcutting. But in the segment from Huayuankou to Gaocun (under the jurisdiction of Dongming County in Shandong), it is characterized by downcutting and widening. The spread is related to the collapse of the flood plain. The flood water of Yongdinghe is controlled by the Guanting Reservoir, and the people have gradually become complacent about the danger of floods. Some people have built houses, planted trees, quarried rock and sand, piled waste soil and garbage in the flood plain near the Lugouqiao section in Beijing. This seriously blocks flood discharge of the river channel. Since the topography of the Lugouqiao area is higher than Beijing City, when an overflow occurs, the safety of the capital will be directly threatened.

(3) Hydrological Conditions and Changes in Water Quality

Building a reservoir will alter hydrological conditions. According to the different purposes of reservoirs, the flow of water is regulated or counter-regulated, thus, the runoff of the river channels is partially or completely controlled. A reservoir used mainly for the generation of electricity has a relatively even distribution of water during the year. The supply of water for living by residents and navigation is also generally even. But reservoirs used mainly for irrigation do not have an even supply of water during the year.

The other hydrological state of a reservoir is its storage of water which elevates the water table and causes the banks of the reservoir to collapse. The loess banks of China's northern reservoirs frequently collapse because of the storage of water in the reservoir and the sudden drop in water level. This type of collapse not only increases the amount of silt in the reservoir, it also threatens the safety of residents along the banks. Land is lost and nearby highways, railroad foundations and buildings are destroyed. By the end of 1961, the amount of earth of the collapsed banks of the Sanmenxia Reservoir was 177 million cubic meters, constituting about 16.2 percent of the amount of silt in the reservoir during the same period. The collapsed banks have created a loss of about 20,000 mu of cultivated land and more than 40,000 forest trees along the eastern banks. This has forced the village of Yangjiawan in Lingbao County to be moved back.

Elevating the water table will also cause damage by soaking. The growth of forests, fruit trees and agricultural crops surrounding the reservoir is

affected. The stability of buildings is reduced or destroyed. In 1957, the water in the Guanting Reservoir once extended out 478.0 meters. With the relatively large amount of rainfall during the previous period, the content of water in the soil increased. After being frozen during winter, water and mud became sludge during the following spring, and serious soaking occurred. According to statistics, in 1957, the area of soaked cultivated land along the banks reached more than 28,000 mu and the number of trees soaked in water amounted to 2,000. More than 6,000 houses collapsed.

Because of sedimentation in the area of reservoirs, turbid water may become clear and the water quality may improve. But reservoirs frequently include more complex phenomena, for example, changes in water quality caused by chemical and biological activity. When reservoirs provide water for industry and for living of urban residents, there are special requirements.

(4) Impact of Reservoirs on Climate and Downstream Water Temperature

To a slight extent, large reservoirs also affect the climate of the local region. This is because after the reservoir is built, the body of water in the area of the reservoir increases and the water surface area expands. According to data on the Danjiangkou Reservoir area, the average water temperature in the river channel over many years was 16.6°C. After completion of the reservoir, it rose to 17.9°C, an increase of 1.3°C. But the climate before and after building the reservoir did not change much. The average atmospheric temperature over many years in the area of the reservoir before the reservoir was built was 15.8°C and it was 15.6°C after the reservoir was built, a difference of only 0.2°C.

After building a reservoir, the amount of evaporation from the water surface visibly increases over the amount of evaporation from the ground covered by vegetation before it was built. This allows more water vapor to enter the air, regulates the heat from solar radiation, and causes slight changes in the distribution of rainfall in local areas. The water surfaces of large reservoirs in China's south are mostly cool in summer. The atmospheric strata are stable. The function of atmospheric convection is weakened, and rainfall is reduced. The opposite occurs during winter. The water surfaces are warmer, the atmospheric strata are unstable, the functions of atmospheric convection is strengthened, rainfall increases, and the annual amount of rainfall changes. For example, within 50 kilometers surrounding the Danjiangkou Reservoir, the amount of annual rainfall within 10 kilometers surrounding the area of the reservoir before the reservoir was built dropped about 12 percent after the reservoir was built. The annual amount of rainfall at the center of the Xinanjiang Reservoir was down by 150 millimeters and the amount of rainfall in the surrounding area of the reservoir dropped by about 100 millimeters.

After a reservoir stores water, thermal changes in the body of water are mainly due to thermal exchange between the surface of the water and the atmosphere, differences in the amount of heat between the water entering the reservoir and the water flowing out of the reservoir, and thermal exchange between the body of water and the soil at the bottom of the reservoir. This type of water temperature difference varies at different depths.

The water temperature of the surface layer of a reservoir is high, and the water temperature of the bottom layer is low. The variation in water temperature greatly affects agricultural irrigation and fish cultivation. When releasing water, measures should be taken to increase the temperature of the water released. From 1963 to 1966, the water of the bottom layer of the Sanxipu Reservoir in Zhejiang province was used for irrigation. The average per mu yield of paddy rice was 918 jin. In the winter of 1966, the surface layer of the reservoir was used for irrigation. According to statistics for the 4 years from 1967 to 1970, the average yield per mu of paddy rice was 1,163 jin, an increase of 27 percent compared to that using the water of the bottom layer of the reservoir for irrigation.

If there is a thermal power station along the banks of a reservoir, the release of water by the thermal power station will increase the downstream water temperature. The first stage construction of the Qinghe Power Plant on the banks of the Qinghe Reservoir in Kaiyuan County, Liaoning Province was completed in 1975. Water of the reservoir was utilized for cooling. The surplus hot water (water temperature of 20°C) was directly released downstream for irrigation. The per mu yield of paddy rice increased from 540 jin to 600 to 700 jin. But beyond 20 kilometers to 40 kilometers, the water temperature gradually approached the natural atmospheric temperature, therefore the function of producing increased yields was not great.

(5) Seismic Effect

Large reservoirs may induce earthquakes when storing water. In 1965, an earthquake occurred less than 1 month after the Kremasta Dam in Greece began storing water. On 5 February 1966, another earthquake of 7 to 8 on the Richter Scale occurred. Five hundred houses collapsed, and 1,200 more were seriously damaged. Serious leakage of water occurred at some sections of the dam. The site of our Xinfengjiang Reservoir is not in a strong earthquake region. After it began storing water, earthquakes gradually developed as the water level rose. In March 1962, the region downstream from the dam suffered an earthquake of 6.1 on the Richter Scale. Afterwards, violent aftershocks gradually slowed down and weakened over a period of more than 1 year. At present, people hold two views on the main cause of induced earthquakes by storing water in reservoirs. One view believes that the weight and pressure of water and seepage of water into faults increase the sliding movement between the surfaces of rock layers and reduces the stress under natural conditions, and thus they induce earthquakes. Another view believes that after a reservoir stores water, water pressure in the pores of rocks increases, and the strength of the rocks is reduced, thus, faulting occurs and earthquakes follow. The earthquake induced by the storing of water in the Xinfengjiang Reservoir was a result of the former cause. The channel of permeation of the Xinfengjiang Reservoir is a fractured zone of a fault of silicate structure. Water produces fluidic pressure inside the crust and causes a change in stress. This is an important reason that triggers earthquakes produced by reservoirs. But, there are still different opinions in this regard and further study is needed to understand the patterns.

To prevent the possibility of inducing earthquakes during the beginning period of storing water in a reservoir, seismic monitoring and measurements must be conducted before and after the reservoir stores water and during the course of storing water in the reservoir. When slight seismic activity occurs during the beginning period of storing water in a reservoir, special care must be taken to elevate the level of the water stored in the reservoir slowly.

II. Impact of Reservoirs on Living Organisms

The impact of reservoirs on living organisms is a new topic. The building of reservoirs not only affects the ecological systems on the ground, it also affects the underground ecological systems existing before the building of the reservoirs. For example, physical and chemical changes will create changes in microorganisms and thus affect plants and higher life forms.

(1) Contagious Diseases

As the water surface area of the body of water stored in a reservoir enlarges, water plants near the reservoir and on the banks of the reservoir will flourish. They are suitable for the growth of malaria mosquitos and snails, which increases the danger of spreading malaria and blood flukes.

Before a reservoir stores water, the bottom of the reservoir should be inspected to see if there is a history of contagious diseases. Lavatories, manure pits and tombs that act as media of contagious diseases should be specially sanitized.

(2) Plants

Reservoirs may affect plants during their construction or during their operation. During the construction period, ground surface vegetation in grassland and forests will be destroyed in the flooding area of the reservoir, the area of intensive construction, the area for rebuilding roads, fields for extracting building materials, sites for piling rocks and construction machinery yards.

After a reservoir is completed, the land surrounding the banks of the reservoir will be damp as a result of storing water for long periods. This is suitable for growth of certain plants and beneficial to greening the surroundings of the reservoir. But, there are also some plants that due because the land is too damp.

The noramal water level of many of our nation's reservoirs for multiple year regulation is reached only after several years or a dozen years. There is a lot of exposed fertile land between the normal high water level and the level of water stored in the reservoir in ordinary years. Therefore, the problem of utilization of this land in the dissipated area of a reservoir should be specifically studied.

Water in the lower reaches of a reservoir can be channeled for irrigation to change the conditions of growth of agricultural crops.

(3) Fish

After a reservoir stores water, the surface of the reservoir expands. The speed of water flow slows, and the ecological environment of fish changes. Fish species that like fluidity lessen in number because the conditions have changed or migrate to the upper reaches of the reservoir. Certain fish species that spawn sticky roe can also develop and spawn in the reservoir but when the water level fluctuates a lot, the fish roe adhering to water plants will be exposed to sunshine and die. Therefore, reservoirs are suited for artificial cultivation of fish fry. With the fresh feed provided by the continuous flow of organic matter from upstream into the reservoir, fish species that are adapted to living in stationary water or lingering water can propagate rapidly.

Most of the reservoirs in our nation have favorable conditions for developing fishery production. But at present, the level of fish cultivation in reservoirs is very low. According to statistics, of the 30 million mu of water surfaces in our nation, there are still 1 million mu of water surfaces that have not been used for cultivating fish. Of the more than 10 million mu of water surfaces already utilized, the average per mu yield of fish is only 11 to 12 jin. It can be seen that the potential for developing fish cultivation is very great.

When the original river has valuable species of fish that migrate upstream to spawn, building a large dam will cut off the channel of migration of such fish upstream, therefore, we must study the possibility of building fish passageways.

When cultivating fish in reservoirs, water passageways of the key project and flood discharge facilities should have devices to block the passage of fish to prevent fish from escaping and to prevent the water turbines of the reservoir for generating electricity from damaging the fish, and even to prevent fish from causing accidents during operation of the power station.

When a reservoir first begins to store water, turbidity in the reservoir increases because inorganic residues left over from construction flow into the reservoir. This is unfavorable to the growth of fish. When storing water, the original ground vegetation and organic substances in the soil dissolve in water and consumes dissolved oxygen. Especially in the deep water layers of the reservoir, because the dissolved oxygen consumed cannot be easily replenished, serious shortage of oxygen occurs, therefore, water released from the deep water layers of a reservoir will affect the growth of fish within a definite distance along the downstream river channels. Large reservoirs require a long time to fill. When a large reservoir is filled, the downstream flow will be less. This will affect the growth of fish in the downstream river channels. When a reservoir is near an estuary and when the amount of downstream discharge of the reservoir lessens, salt water flows backward. This also affects the growth of fresh water fish.

In addition, when cultivating fish in the reservoir, substances harmful to fishery resources should be prohibited from being released into the reservoir.

(4) Animals

Birds, mammals, reptiles, amphibians, shellfish and insects migrate as the area of forests and the land area surrounding the reservoir lessen. The environment for finding food and building nests will undergo a definite change.

When planning and designing a reservoir, surveys of the species of animals, the areas inhabited by living organisms and the pattern of propagation must be conducted. Possible changes in living conditions of more rare animals that may occur after completing a reservoir must be considered, and protective measures should be studied to prevent extinction. After the reservoir stores water, grounds where hunting is prohibited should be zoned. Protective regulations can be established to protect attractive migratory birds that have been attracted to the reservoir.

III. Impact on Human Life

(1) Flooding Due to Reservoirs

Building reservoirs requires moving the population in the reservoir area. Water from the reservoir may flood land, ancient artifacts and ruins, mineral deposits and other facilities, and the construction of reservoirs may require rebuilding railroads, highways, power lines and communications lines. The problem of flooding due to reservoirs is not only related to the correct selection of the scale of the ater conservancy project, it is also related to the restoration and development of production by the people, life and regional economics of the people moved from the reservoir area.

Many of the reservoirs built since the founding of our nation still have lingering problems because of imperfect considerations and inappropriate handling. This not only affects the enthusiasm of the masses for building reservoirs, it also affects the development of the gain of the engineering project. It is worthwhile for our water conservancy departments and related departments to learn some lessons from such experience.

(2) Downstream Damage

Besides those mentioned above, there are the following:

1. The flow of water to a diversion type hydroelectric power station and other diversion projects (such as diversion across regions) has been interrupted and sections without water have been created. This has affected the use of water by industry, agriculture, people and animals of the local region. The treatment of the problem of sections without water and the treatment of the problem of flooding due to reservoirs described above are equally important.

2. Accidents of large dams will create massive damage in the lower reaches. There have been many painful examples in our nation and in foreign nations. There are many causes of dam accidents such as mistakes in regulating and

using the dam, slightly lower hydrological calculations, irrationality in structural design, poor quality of construction, malfunctions or breakdowns of flood discharge facilities during an overwhelming flood, and destruction by man and wild animals. In active earthquake regions, a major earthquake would also endanger dams.

To reduce the damage in the lower reaches when an accident occurs in a large dam, besides stopping the above causes, the scope of the impact of a collapsed dam and the time and water level of advancing flood waters must also be estimated, and plans for emergency evacuation of residents and important materials must be drawn up.

To prevent accidents at large dams, design and construction of the main reservoir must be done well, and during operation and management of these dams, a system of inspection must be established. As soon as an abnormal situation is discovered, necessary measures must be taken immediately.

Important reservoirs must have a reliable and rapid communications and warning system. When there is a sign of danger, an alarm must be issued immediately so that residents can be safely evacuated in time and important materials can be rapidly transferred.

3. As described above, large dams not only block the flow of water, at the same time, they also block navigation and the flow of logs in river channels. This means that when building a dam, the possibility of building structures for navigation (such as ship locks, lifting locks) and log chutes should be considered at the same time so that requirements for use of the waterways by the various sectors of the national economy can be satisfied as much as possible.

(3) Pollution of the Reservoirs

Pollution of reservoirs can be classified into two types according to the source: One is natural pollution. This refers to pollution of the water source of a reservoir during natural runoff. It is the result of the confluence in the reservoir of river water containing toxic substances produced by some chemical elements or by the rotting of natural plants due to special geological and natural conditions of the river valley controlled by the reservoir. The other type is caused by human factors, such as the release of industrial waste water, agricultural waste water and human waste at the upper reaches of the reservoir. Such waste enters the reservoir via the river channels and causes the water quality to worsen. This is also called man-made pollution. The former should be considered according to the purpose of the reservoir at the time of planning and designing the reservoir. The latter is a matter of controlling the human activity which causes the pollution.

When building large and medium reservoirs, factories, tourist facilities, sanatariums and farms are frequently built around the reservoirs. These units frequently release large amounts of oil, oily suspended substances, chemicals and such harmful and toxic substances and other harmful wastes which pollute the water quality of a reservoir.

Pollution of a reservoir affects the quality of water supplied by the reservoir for industrial and agricultural use at the lower reaches, it affects the safety of water used by human beings and animals and it affects environmental protection. The frequently seen harmful substances described above include mercury, chromium, cadmium, lead, arsenic, phenol and cyanides.

Pollution of reservoirs causes acute or chronic poisoning of fish in the reservoirs and in downstream river channels. Because toxic substances accumulate in the body of fish and in feed, they are also harmful to people who consume such fish over a long period.

Waste water of the copper mines near the Erlongshan Reservoir in Bing County, Heilongjiang Province was released directly into the upper reaches of Jianganhe without being treated, causing massive deaths among fish in the area of the reservoir from 1972 to 1975. Later, the reservoir had to be drained empty. This affected the gain in irrigation for many years.

Building of new industrial and mining enterprises around the area of reservoirs must be uniformly considered with the building of reservoirs. Units that seriously pollute and do not have treatment facilities for polluted water should be ordered to move away. Those toxic chemical fertilizers and farm chemicals that cause serious pollution must not be used for long periods by farms. Tourist and sanitarium facilities must have purification and treatment facilities for polluted water produced by them and such polluted water must not be released directly into the reservoirs. It should be pointed out that the polluting source of reservoirs can be purified but a lot of investment is required and it is very difficult to eliminate all harmful substances. Therefore, besides implementing methods of purifying polluted water, the more important is prevention. Necessary measures must be taken to prevent harmful substances from being released into the reservoirs.

To a certain degree, reservoirs allow sedimentation, coalescence and dilution of substances flowing into them. But this varies according to the amount of incoming water, the amount of water stored in the reservoir and the amount of incoming toxic substances. The Guanting Reservoir treated some of the harmful substances released by the factories during the beginning of the 1970s. But, at present, Xuanhua upstream still has a paper manufacturing plant, a chemical fertilizer plant and a cement plant that release toxic substances into the Yanghe which flows into the Guanting Reservoir. These have worsened water quality. According to statistics, the river valley of the Guanting Reservoir has 23 medium and small cities and 242 factory enterprises that release polluted water into the river channels. The annual release of polluted water reaches 116 million tons, and 40 percent of this contain harmful substances. Observing the polluted water flowing into the reservoir, we see that the amounts from Yanghe and Shangganhe are the largest. Although the amount of polluted water from Weishuihe and Shacheng on the bank is small, but the polluting source is relatively close to the reservoir and the self-cleansing ability is weak.

Because the water source is polluted, when the reserve of water in the Guanting Reservoir is less than 300 million cubic meters, the contents of phenol,

mercury, and cyanides in the water all surpass the allowable amounts by national standards. Therefore, the Guanting Reservoir Administration believes the water quality alert level of the reservoir is 200 million cubic meters.

(4) Scenic Attractions and Tourism

When designing a reservoir, besides considering the technical possibilities and economic rationality, aesthetic considerations should also be taken into account. Large dams can change the scene of the dam area and the surroundings. This is especially important for reservoirs that possess a tourist character. The scenery of large dams and reservoirs must harmonize with the surrounding scenery.

Some reservoirs are recreational reservoirs. They must maintain a definite water level during the tourist season. For example, the water level of the Shisanling Reservoir in Beijing was once established at not lower than 90.0 meters. This is the requirement of the tourist industry.

Trees and buildings in the region of a dissipated water level in a reservoir should be removed when cleaning the reservoir to facilitate fishing and navigation in the area of the reservoir.

To beautify the natural environment, we must protect precious natural scenery. We must especially protect artifacts and ruins, open tourist highways, hostels, plan uniformly so that the natural scenery of the area of the reservoir is in harmony and the environment becomes more beautiful.

(5) Construction

At present, the general construction period of China's water conservancy hubs is long. Relatively more laborers are involved, and construction machinery at the construction sites often create noise, dust, smoke, waste gas, waste water, waste rocks, powder, coal dust, garbage and polluted water. The local environment and the life of residents have been destroyed. Therefore, when designing construction and during the entire course of construction, we should consider the harmful contents of pollutants released, estimate the amounts to be released and plan the method of releasing pollutants and the course of pollutants to avoid or reduce such effects as much as possible. For example, when selecting traffic lines, can they be combined with the local traffic routes; using natural conditions as much as possible in planning the sites for dumping soil, waste rocks, waste materials, and in planning sites for yards to store construction materials so as not to hinder the productive activities and life of the residents; use methods of treating waste material that can re-utilize waste; it is best that the polluted water from washing sand and rocks be treated by sedimentation before it is released into the river channels; temporary buildings should destroy the natural environment as little as possible, or practical remedial measures that can be implemented later.

IV. Two Suggestions

1. Water conservancy departments and various economic departments must all pay attention to the unfavorable impact of reservoirs upon the environment, and they must place sufficient emphasis on such impact. Any unit that sacrifices and destroys environmental ecology in exchange for the development of production is absolutely wrong.

2. The relationship between the building of reservoirs and the environment fundamentally speaking is having the same goal. The two are mutually promoting and mutually influential. The massive function of the reservoirs mentioned above shows that reservoirs themselves improve the environment, promote the development of production, create benefits for the people, but if the planning and design of reservoirs are inappropriate or if their utilization and management are poor, and if the quality of construction is not good, they will bring about an unfavorable impact on the environmental ecology. They will also harm the people, therefore, as we utilize water conservancy resources to the maximum extent, we must also protect the environmental ecology as much as possible.

9296
CSO: 5000/4035

OVERALL AND ECONOMIC VIEW OF ECOLOGICAL BALANCE

Beijing GUANGMING RIBAO in Chinese 5 Feb 82 pp 2, 3

[Article by Ma Shijun [7456 0013 7486], Chairman of the China Ecology Society and member of the Academic Department of Biology of the Chinese Academy of Sciences: "On Overall and Economic View of Ecological Balance"]

[Text] Beginning in the mid-1950s, the laws of mutual relations among the many elements of nature were neglected during the course of intensive development of industry and agriculture and the massive exploitation of natural resources. Therefore, the problem of ecological imbalance has emerged. It has threatened the life of mankind and socio-economic development. It has also provided a new comprehensive subject for ecology and sciences related to ecology.

In nature, a relatively stable dynamic balance is achieved via a complex process of flow between material and energy and mutual action between inorganic environmental elements and living organisms. Ecological systems which are the functional units that make up nature possess definite structures and special functions, including control and transmission of information for "regeneration", "symbiosis", "mutualism", "sequential growth" and "self-construction", "self-repair", "self-adjustment" and "auto-selection".

The complete structure of an ecological system consists of many basic units and secondary systems. It is a multi-dimensional structure. The special functions are determined by the different combinations of units of many different properties or several units that are the same. The multiplicity of life forms in nature and the complexity of mutual relations make an ecological system a very complex system with many elements and many variables, and many subsystems are formed from the different variables and their different combinations as well as changes within a definite range of variation of these different combinations. The diversification of subsystems is not only related to the number of parameters and the properties of the parameters, it is also closely related to the mutual relations between parameters and parameters. The subsystems have their own special functions and definite structure within the entire ecological system, and they are indispensable components of the entire ecological system. Recognizing the relationship between nature and the ecological systems and the complex relations between the whole ecological system and its subsystems is very important in clearly understanding the problem of ecological balance.

The following expresses two personal views on the question of ecological balance.

The Overall View of Ecological Balance

Ecological balance refers to the mutual relations between living organisms and between living organisms and their environment in a system. The stability manifested among the three is a characteristic of the ecological system. The ecological balance of a certain region is determined by the specific living organisms and environmental conditions of that region. The network formed by the living organisms and the environment is the foundation of forming an ecological balance. Without the entirety of the mutual relations in nature, the problem of ecological balance in nature will not exist. Similarly, in a semi-artificial and artificial ecological system, if mutual relations among the many elements are not established, there is no ecological balance. The entirety relies on a definite structure and corresponding functions. The structure provides the channels for the flow of materials and the flow of energy. It is the framework for establishing the interconnection between the units or the subsystems. The completion of normal functions must rely on a definite structure and also on the balance of the output and input of materials and energy, the transmission of information, the inorganic environmental states formed jointly by physical and chemical conditions before it can complete the "regenerative" function. In the present situation, maintaining coordination between water and heat, increasing the vitality of the soil environment and increasing the self-cleansing ability of the environment are outstanding problems.

The ecological balance formed within a natural biogeographic region does not mean that all units or all subsystems that make up the entire system are in an absolutely stable state. In fact, the entire system can maintain relative stability exactly because of the ceaseless processes of mutual exchange, compensation and regulation among the units or the subsystems. Evolution of life is a process of a continuous jump from one stable state to another more orderly and stable state which better suits the selective functions at the time. If the old state of stability always remains stable, progress towards a new state will not occur. Only by losing balance--sudden change or readaptation can a new stable state be reached to push forward the continued development of nature.

Because ecological balance allows proportional changes of the components (species) of the structure under the prerequisite that normal functions are basically guaranteed within a system, the complexity of the structure is appropriately simplified. The coordinated proportion of water and heat and the amount of material for regenerative functions which have to be maintained in a certain region vary according to the types of physical entities that compose the system, and there are regional patterns which can be followed. The classification of regional characteristics mainly rely on climate, soil, vegetation and social factors.

The Economic View of Ecological Balance

Economic ecology is a new branch of science that has developed in recent years. It uses the viewpoints and methods of economics to describe the laws of ecology. It emphasizes the study of ecological problems that occur during the course of high speed economic development, and how economic principles and ecological laws can be utilized in combination. We know that in an ecological system that has developed well, its structure and function are coordinated. Self-regulating functions are present between the units and the subsystems, therefore the working efficiency is high. But, when the entire system is in a state of balance, it is generally believed that its biological elements, i.e., animals and plants, have already reached a maximum number. The various life forms are very closely connected. The amount of living matter produced by the realm of living organisms is completely absorbed and utilized by living organisms and the net production value is near zero. In other words, the pure economic gain during that stage is not high. This requires the use of economic viewpoints to improve the structure of the system on the basis of guaranteeing the normal functional channels according to ecological laws and to change the system with a low economic gain into a system with a high economic gain so that it can fit the requirements of economics of human society.

Economic ecology requires people to account for everything and account for the total in balancing the gains and losses of the entire system. Any construction project that affects regional natural functions and any measure that reforms the local natural ecological environment must be considered under the overall view and the economic view simultaneously, this means taking their economic gain and their ecological gain into consideration, and they must coincide with the following principles:

1. They must benefit the locality and they must also benefit the entire situation or at least not harmful to others;

2. They must benefit the present, take the future into account, and at least not harmful to the future;

3. They must help improve the people's life or not be harmful to human health.

Therefore, the development and utilization of regenerative natural resources must emphasize both utilization and cultivation so that the sources and supply will not be exhausted. Nonregenerative resources must be clearly understood. The balance of payments must be weighed, and ways must be opened up on a broad basis to suit the needs of population growth and economic development.

Conclusion

Our nation has already accumulated some experience in the improvement of ecological systems according to ecological laws and in rebuilding and restoring natural ecological balance. We should conscientiously summarize it. At present, our nation is in a stage of readjustment and at the beginning of high speed development of the economy. Serious imbalance of ecological

balance has already occurred in some regions. We must campaign for an emphasis on the entirety of ecological balance and on implementing the principles of economic ecology in industry, agriculture and water conservancy construction. Experience tells us that any large construction project will involve many factors and will involve the knowledge of several and even many sciences. And there is no doubt that comprehensive problems must be solved by comprehensive measures and methods. Now, ecological thought has already penetrated scientific research work on a broad basis, but it has not been sufficiently manifested in our nation's industrial and agricultural construction projects. Our nation is a nation with a large population and a wide expanse. The ecological and geographical environments are many and varied. Now, people are beginning to recognize the importance of suiting measures to local circumstances, but regarding the profound meaning of "local circumstances", especially the interconnections between the various elements that compose this real space, it seems that people have not yet learned any profound lessons from past failures. This is worth propagandizing in a big way by our comrades engaged in ecological work.

9296
CSO: 5000/4024

SHANXI POLLUTION WORK FOCUSES ON PROTECTING AGRICULTURAL LAND

Taiyuan SHANXI RIBAO in Chinese 25 Dec 81 p 2

[Article: "Resolutely Prevent and Control Environmental Pollution, Rationally Develop and Utilize Water Resources"]

[Text] In his report on governmental work, governor Luo Guibo [5012 6311 3134] stated that the pollution of Shanxi's atmosphere and water resources is becoming more serious each day, and has done great harm to human health and the ecological balance. We must resolve to systematically prevent and control environmental pollution.

He reiterated that all new construction, expansion, reconstruction and major renovation and modernization projects must follow the "three simultaneous" principles and that the relevant departments must exercise strict oversight. All organizations which discharge wastes in excess of standards must be fined according to regulations and be assigned a deadline for dealing with the problem. A major effort must be made to move ahead with construction for Taiyuan's conversion to gas, and use of gas by the public must be developed in step-by-step fashion. The cities of Taiyuan, Datong, Yangquan and Changzhi must carry out boiler modernization, modernize cooking ranges used by the public, and extend the use of honeycomb briquet stoves.

The work of expanding the renovation of our territory, and effective exploration, development, utilization, management and protection of our national resources constitutes a major task. The most pressing task at present is protection of agricultural land, thrifty use of land, and sparing, rational use of every inch of land. Strict control must be exercised over the taking of land for capital construction and the use of land for private dwellings. Rational development and utilization of water resources is another important task of renovating our country's territory. The problem of inadequate water resources is currently a very pressing one in this province; industrial, agricultural and public water use are steadily increasing, and there is serious waste. If this tendency is not altered, in a few years the water shortage will reach disaster proportions. Accordingly, the province and the localities must establish organizations for managing the development and utilization of water resources, and the drilling of deep wells must be approved by county level or higher water conservancy departments. In the localities where water resources are scarce, plants with high water consumption may not be built, reconstructed

or expanded. Industrial and mining enterprises must energetically expand water recycling, multiple utilization of water and wastewater recovery. Agriculture must effectively manage and use existing water conservancy facilities and replace the method of slow irrigation with large amounts of water. Water meters must be installed in offices, factories and mines, army units, schools and urban households, and a major effort must be made to conserve water. For the long term, the primary means of solution is a major expansion of water conservation through afforestation.

8480
CSO: 5000/4019

EXISTENCE OF ACID RAIN NO LONGER DOUBTED, AUTHORITIES URGED TO TAKE ACTION

Beijing GUANGMING RIBAO in Chinese 5 Feb 82 p 2

[Article by Zhao Dianwu [6392 3013 0063]: "Delegates to the 'Discussion Meeting On Pollution of Rain and Acid Rain' Point Out That Acid Rain Has Occurred In China and Concerned Departments Should Strengthen Observation and Research"]

[Text] Does China have acid rain? This was the major topic of the "discussion meeting on pollution of rain and acid rain" held recently in Beijing. The scientific and technical personnel of environmental protection and meteorological departments of some of the provinces and cities throughout the nation participated in this discussion meeting.

The answer to this question is positive. Observations during the past two years show that acid rain has occurred in some cities in China. In some of these cities not only is it a common occurrence, the acidity is also very high. The corrosion of building materials and metals observed at some localities and the poor growth of forests may be related to acid rain.

Acid rain is closely related to energy resources. Sulfur dioxide and nitrogen and oxygen compounds released by the burning of coal and petroleum are oxidized to become sulfuric acid and nitric acid in the atmosphere or in rain drops. This is the cause of acid rain. But the atmosphere also contains alkaline substances which can neutralize acids. Therefore, the formation of acid rain is related to the release of sulfur dioxide as well as other pollutants in the atmosphere and the topography, weather and soil properties of the localities. For example, the coal burned in Zhongqing City has a high sulfur content. The topography and weather conditions are favorable to the oxidation of sulfur dioxide into acid. Acidic soil also reduces the amount of alkaline substances in the atmosphere. These may be the causes for the occurrence of rain with a higher acidity.

The atmosphere of many cities in China has been polluted by sulfur dioxide to varying degrees. Under this situation, what is the situation for acid rain in the whole nation? What harmful results will be brought about by acid rain? How can acid rain be treated? These questions are worth everyone's attention, especially the regions in the south where coal with a high sulfur content is burned.

Rainfall is the only source of ground surface water. We cannot concern ourselves only with the amount of rainfall while neglecting water quality. Therefore, the meeting suggested the departments of environmental protection and meteorology strengthen the observation and research in acid rain.

9296
CSO: 5000/4024

MEASURES FOR IMPROVEMENT OF BEIJING AIR QUALITY SUGGESTED

Beijing HUANJING BAOHU [ENVIRONMENTAL PROTECTION] in Chinese No 5, 1981 pp 4-6

[Article by Zhang Yichuan [4545 0110 1557]: "Some Views on Methods of Solving the Capital's Air Pollution"]

[Text] When the winter heating season arrives, the entire capital is covered by smog. In recent years, the cognizant departments have taken active measures to deal with air pollution in the capital, but the pollution situation not only has shown no essential improvement, but is actually becoming steadily worse. Under these circumstances, it will obviously be extremely difficult to implement the Central Committee Secretariat's proposal that "Beijing should be turned into a first-class city, the cleanest, healthiest, most beautiful in the world."

The sources of air pollution in the capital are numerous, but the main source is direct combustion of large quantities of coal. In 1980, coal accounted for 77.1 percent of the fuel used in Beijing. Not only is this proportion higher than in Shanghai and Tianjin, it is also higher than the national average figure of 71.6 percent. In civilian energy consumption, including heat supply by heat and power stations and electricity for daily use, coal accounts for 78.6 percent of fuels used; excluding heat supply from heat and power plants and electricity for daily use, the figure is 89 percent. These fuels are concentrated in the city proper, and fuel use in the city and nearby suburbs accounts for 80 percent of total fuel consumption. The result is the emission of nearly 300,000 tons of sulfur dioxide and more than 400,000 tons of ash into the air every year.

According to statistics from the relevant departments, the capital has more than 10,000 boilers of various types, more than 6,000 water heaters and more than 10,000 smokestacks. Among these boilers, about 60 percent are for heating (primarily small boilers with steam production capacities less than 2 tons per hour), and only a third are mechanically stoked, while the rest are manually operated. Only 10 percent of boilers have ash control equipment. Some 87 percent of these boilers and 78 percent of the water heaters are located in the city proper and nearby suburbs, accounting for only 5 percent of the municipal area, in addition to which there are more than 2,000 industrial furnaces and more than a million small stoves used by offices, shops and establishments for cooking and heating, so that once water arrives, smoke and

ash arise everywhere in Beijing city, and particularly in the central urban area, irritating the nasal passages and making it difficult to find one's way about. In the past 10 years, the cognizant departments have made considerable efforts to rectify this situation and have repeatedly undertaken boiler modernization work. In the 1960's, iron foundry boilers dating from the 1950's were converted to straight-tube type water tube boilers; in the 1970's, quick-mount boilers and side-mount reversing row-type boilers were installed. Every year the housing management departments and environmental protection departments expend more than 1,000 tons of steel materials, along with manpower and material resources, for boiler conversions. But because of the low efficiency of existing small boilers and the fact that they burn second-quality coal, and in particular because they lack effective ash control and sulfur removal facilities, large quantitites of ash and sulfur dioxide and other harmful substances are still emitted into the air, so that despite all efforts to improve it, there has still been no clear change for the better in air quality.

Below, several suggestions for improving the capital's air pollution situation are put forward for discussion with comrades in the field and those concerned about improving the city's environment.

1. We should actively pursue centralized heat supply. Centralized heat supply will have a major effect in decreasing atmospheric pollution. Beijing's eastern suburbs are an area in which large-scale plants are concentrated, but because centralized heat supply is used, the sulfur dioxide concentrations during the winter heating season are only 0.09 mg/m^3, while in the central city, which lacks centralized heat supply, concentrations reach 0.27 mg/m^3. According to calculations by the city's environmental protection office, the pollution effect produced by small stoves (i.e. the degree of pollution produced by the burning of a given quantity of coal) is more than 60 times as great as for large boilers with high smokestacks.

At present, efforts must be made in three main areas to implement centralized heat supply in Beijing. First, full use must be made of the two already-constructed heat and power stations, particularly the No 2 Heat and Power Station, which thus far has not achieved its design capacity; an effort must be made to realize the original plan of supplying heat to an area of 5 million square meters in the eastern suburbs and tearing down more than 200 smokestacks. Second, in industrial areas with a year-round heat load such as Qinghe, Daxiaoting, Songjiazhuang and the like, new industrial heat and power plants of various sizes should be constructed in accordance with specific circumstances. In addition to meeting industrial heat needs, these industrial heat and power plants should also take care of the heating needs of residences and other buildings in surrounding areas. Third, when developing of centralized boiler plants of various sizes for centralized heat supply, relatively large-capacity boilers should replace large-quantities of scattered low-efficiency small boilers, and improvement of boiler efficiency should be used to decrease coal consumption, thus both saving energy and decreasing air pollution. At present the implementation of such centralized heat supply from such boiler plants is well under way. Their heat supply range is relatively flexible. At the same time, centralized boiler plants require a much shorter construction time than heat and power stations and are easier to fit into new

tract residential districts. When developing centralized heat supply for the public, large and medium-sized hot water boilers should be used, because their efficiency is relatively high (generally 75 to 80 percent), so that they would save 60 kg of coal per million kcal of heat supplied compared with commonly-used heating boilers. This means that theoretically, 72 tons of coal a year could be saving in the supply of heat to 10,000 square meters of building space. Given the usual conditions of new residential construction in Beijing, the use of hot-water boilers for centralized heat supply in new tract residential districts where the built-up area does not exceed a million square meters is economically feasible. Currently, the residential tracts being built up in various locations in Beijing only cover a few hundred thousand square meters, and accordingly boiler plants for centralized heat supply can be used in all the tract residential districts being built in Beijing.

2. Rational use should be made of energy, the best quality fuels should be preferentially allocated for private-sector use, and an effort should be made to develop the urban gas industry. With our country's limited oil and gas supplies, rational use of energy is extremely important. Some industrially developed countries preferentially supply the best fuels for use by the public. Currently some of the world's largest cities have already converted to gas, using primarily natural gas. Although in 1980, 66.9 percent of Beijing's inhabitants did their cooking with gas, in the total energy breakdown for the Beijing area, the share of gaseous fuels (excluding noncommercial gas) was only about 1.5 percent, while it was only 9.6 percent of energy consumption by the public. Because of the limited availability of gas, it can only be supplied to the public for cooking and water heating; large quantities of coal-burning stoves and small heating boilers are still in existence throughout the city. Accordingly, gas currently makes only an insignificant contribution to decreasing air pollution. As everyone knows, 1 kg of the liquefied natural gas supplied to the public can replace about 7 kg of coal, while if it is used as an industrial fuel it replaces only 2.5 kg of coal. One kilogram of heavy oil used to produce city gas for public use replaces 3-4 kg of coal, but when directly used in industrial furnaces and electrical boilers it replaces only about 2 kg. Clearly, supplying the best-quality fuels to the public has good conservation results. And at present, when it is difficult to increase the available quantities of oil and gas, implementation of the principle of allocation in accordance with an overall plan and efficient use of energy resources, suitable adjustment of the energy supply and allocation policy, and thorough utilization of the current potential of the energy industry would increase the proportion of high-quality fuels in all fuels supplied to the city and solve the short-term problem of city gas supply. In 1980, more than 2.5 million tons of heavy oil and crude oil were burned in the Beijing area, of which public power stations burned nearly 1.5 million tons. If some power plants which should not burn oil were converted to coal, and if oil consumption by certain industrial boilers were resolutely decreased, some of the heavy oil saved could be used for gas production, pipeline gas supply could be extended, and the gas supply could extend to residential cooking, public welfare, industrial process gas and some heating gas. If pipeline gas supply were expanded it would be possible to replace some of the liquefied gas being supplied to multistory apartment blocks, to supply one-story residences within the city and to carry out experiments with the use of liquid petroleum gas for heating. Some of the heavy oil saved from the

readjustment could also be used for suitably equipped boilers and kilns in critical areas, so as to improve their environmental conditions. Thus, without increasing total heavy oil consumption in Beijing it would be possible to save energy and greatly improve the air quality in the central city area.

3. Rational coal allocation in terms of the technical characteristics of coal-burning equipment. Both the development of centralized heat supply and the rational use of energy resources, with preferential allocation of high-quality fuels to the public and development of the municipal gas industry, require a relatively long period of time. At present, single-story houses are rather numerous within the second beltway (more than 13 million square meters, accounting for about 46 percent of building area in the city), and there are more than a million small stoves and about 3,100 boilers, accounting for a third of all the boilers in the city. Because the roads in the city are narrow and it is difficult to build heat and power stations and large-scale centralized boiler plants for the expansion of centralized heat supply, it is estimated that the situation of dispersed burning of coal for heat supply will have to continue for a relatively long period of time. Under these circumstances, there is a problem of efficient distribution and utilization of energy. Accordingly we should, in accordance with policy, clearly specify that the supply of high-caloric-value, low-ash, low-sulfur-content coal should be guaranteed to medium and small sized boilers in the central part of the city, while lower-quality coal should be supplied to large boilers which can install highly effective ash removal facilities and use high smokestacks, such as those in heat and power stations. But currently the situation is just the opposite: everyone burns what coal he is given, and the variety supplied varies from year to year. Power stations need to burn powered coal, but they are sent lump coal, and medium and small-sized boilers need lump coal, but they are supplied finely-powdered coal. As a result, a reasonable readjustment of coal distribution is an extremely urgent matter for improvement of the quality of heat supply, saving energy and improving the environment, and should be energetically pursued.

4. The optimal method of fundamentally improving the capital's air pollution situation is to improve the current fuel structure, based primarily on coal. This change does not mean ceasing entirely to burn coal, but increasing the proportion of gas and oil used. As everyone knows, London is world-famous for its fogs; but in the 1950's there were several earth-shaking "smog incidents," and in the 1960's, after England developed the North Sea gas fields and natural gas came into use, London's fuel structure changed, with the result that air quality was greatly improved. England achieved these good results with gaseous fuels accounting for only 31 percent of total fuel consumption. Obviously, to improve the environment it is not necessary to replace all coal with oil or gas. In 12 months in 1977 and 1979, because of a lack of wind and the occurrence of thick inversions and fogs which persisted for rather long periods, it is estimated that sulfur dioxide levels in Beijing's air were 2 to 7 times higher than usual, approaching the conditions of London's "smog incidents" and producing widespread concern. We believe that since it is difficult to rectify the situation of dispersed boilers and small stoves in the city, it is particularly important to improve the fuel structure. We hope that the cognizant departments will step up their investigation of oil and gas reserves in the North China region and

provide Beijing with some natural gas: if this were suitably used, there could be a considerable improvement in Beijing's air quality.

Consensus on several questions is especially needed now. For example, on what footing shall environmental protection for Beijing be placed? Why has the problem of inefficient oil and gas burning gone unresolved for a long time, and why is it so difficult to use a little gas and oil in order to improve the capital's environment? The problem lies in lack of consensus. If this consensus could be reached in several matters, so that people were willing to spend a little and a conscientious effort were made to solve certain problems, it would not be so difficult to improve the capital's air quality.

8480
CSO: 5000/4015

SHANGHAI HOLDS CONFERENCE ON HUANGPU RIVER POLLUTION CONTROL

Beijing HUANJING BAOHU [ENVIRONMENTAL PROTECTION] in Chinese No 5, 1981 p 13

[Article: "A Helpful Undertaking in Work on an Environmental Pollution Control Plan"]

[Text] The Huangpu River in Shanghai is a stream of many capabilities: it is the only source of drinking water for the inhabitants of the city, a source of water for industry and agriculture, the basis for port activities and water transport, a sewage outlet and a flood protection and drainage resource. But increasingly grave pollution is already hindering its use for drinking water and threatening the people's health and the development of industrial and agricultural production. It has now become essential to deal with pollution of the Huangpu River. But how can a scientific, feasible control plan be drafted? The "Work Conference on a Pollution Control Plan for the Huangpu River" held between 29 July and 4 August of this year made a helpful attempt to do so.

Specialists and representatives from relevant national departments and from Beijing, Jiangsu, Zhejiang, Wuhan and Shanghai concluded that the overall policy for the Huangpu River should be "coordination of long-term and short-term measures, attention to both causes and results, integrated protection, gradual implementation," and "developing the sources of pure water and limiting the flow of sewage," with work focusing on the next five years. The general consensus was that the overall plan should include the measures described below.

1. A unified plan for protection against pollution sources. For both the near term and the long term, controlling discharges by industrial enterprises should be the main focus of integrated pollution protection for the Huangpu River. Because there are already more than 6,000 plants crowded closely together within Shanghai city, it is difficult to improve the geographical distribution of plants. But industry enjoys certain advantages in Shanghai, and if these are thoroughly utilized a certain pace of development can be maintained in the future without an increase in the qualities of pollutants discharged.

2. A water quality plan. The systems approach should be applied, water quality simulation studies undertaken, and overall control of pollution sources exercised. The purpose of this work is to assure that all of the potential of the Huangpu River is developed. The water quality plan will be rather technical in nature and will require rather large amount of basic work: synchronized studies of water quality and hydrography, water quality evaluation and the like.

On the basis of the water quality plan, the environmental protection departments will be able to carry out overall planning and take account of the entire situation, conduct analysis and comparison of various pollution control programs, and arrive at ways of achieving water quality standards with minimum investment while meeting the water-quality requirements of the various water-using departments.

3. A water resources protection plan. The Huangpu River is a tidal river and its dilution and self-purification capabilities are affected by the upstream water quality and tides, so that it is necessary to maintain a certain water quality in the river, to increase the river's discharge during the dry season and to protect the quality of the water sources that feed it. Improving drinking water quality is a long-term task in Huangpu River pollution control, but it must be suitably carried out in the near term. At present, thought should be given to better location of water intake points and improvement of water purification processes. Improving the water intake points and improving the quality of the water withdrawn constitute a relatively feasible and fundamental approach, but they should be combined with a water resources plan to assure that during the dry season there is a relatively stable flow at the water intake points and that the watershed area will be suitably protected.

4. A plan for the construction of a municipal sewage treatment plan. The size, location and treatment requirements for the sewage treatment plan should be closely coordinated with the overall plan.

This conference has resulted in relatively clear ideas regarding the overall policy for pollution control in the Huangpu River, and its objectives and specific content. This is not only a favorable step in the work of controlling pollution in the Huangpu River, but also a helpful attempt at regional environmental pollution control work.

The Shanghai Municipal Party Committee and the Municipal People's Government attached extremely great importance to this conference, and municipal party committee secretary and Deputy Mayor Comrade Han Zheyi [7281 0772 0001] spoke at it.

8480
CSO: 5000/4015

SEAWATER POLLUTION AT YANTAI REDUCED

Beijing HUANJING BAOHU [ENVIRONMENTAL PROTECTION] in Chinese No 5, 1981
pp 13, 17

[Article: "Yantai Ocean Fishery Company Decreases Harbor Water Pollution"]

[Text] Since the beginning of the 1970's, pollution in Yantai Harbor has been steadily becoming more serious. The main reason for it has been discharge of large quantities of industrial wastewater and domestic sewage into the sea, in addition to which, as maritime transport and fishing boat traffic have rapidly expanded, the ships themselves have been discharging oil-containing water. In the past, every time the fishing boats underwent dock overhaul they had to clean out their oil tanks, and the ships would generally discharge 4 to 6 tons of oil-containing wastewater. Since every year this company carried out dock overhaul of an average of 50 fishing vessels, about 200-300 tons of oil-containing wastewater was discharged, in addition to the water discharges resulting from cleaning of oil tanks and oil barges, which brought the total to more than 400 tons. The discharge of this oil-containing water into the sea caused a certain amount of pollution of the sea area around Yantai Harbor.

In order to prevent further pollution of Yantai Harbor and make the beautiful harbor "an area of blue-green mountains and jade-green sea," starting in 1978 the Yantai Ocean Fisheries Company organized its engineering and technical personnel for a study of discharge of oil-containing wastewater by fishing vessels; they coordinated long-term planning with short-range measures and drew up a four-point plan. First, test development of an 0.2-ton-per-hour small-size oil separator suitable for wastewater treatment by fishing vessels while on the fishing grounds was to be carried out. An experimental model underwent shipboard testing and evaluation and basically met the original design requirements; in September 1980 it was evaluated by the Shandong Province environmental protection office, and the treated wastewater it produced met state discharge standards. As a result, this product received a Shandong Province Class 3 prize for scientific achievement in 1980. In the second half of this year the device went into small-series production. Second, a set of oil-containing wastewater treatment facilities were to be installed within the harbor so that wastewater from the repair of fishing vessels and from the rinsing of oil tanks, oil barges and oil tankers could be fully treated. After precipitation, heat treatment and filtering, clean water was discharged into the sea with an oil content not exceeding 1 liang

per 10,000 jin of water, which was entirely in accordance with state wastewater discharge standards for harbors. This not only protected the water area of Yantai Harbor from pollution, but also led to the recovery of large quantities of diesel oil from the wastewater, resulting in a saving of energy. Statistics indicate that between the end of 1978 and May of this year, a total of 251 tons of diesel oil was recovered, with a value of more than 30,000 yuan. This recovered diesel oil can be used in the same manner as ordinary diesel oil. The installation of the entire set of equipment required an investment of only 15,000 yuan, so that in the 2 1/2 year period it has more than repaid the initial investment. Third, to deal with the petroleum pollutants accumulating in large quantities in the bilges of motorized fishing vessels being repaired within the moorage area, preparations were to be made for an oil separator to be mounted on an auxiliary ship in the harbor, allowing it to pump out, separate and filter the oil-containing bilgewater. Currently the equipment for this ship is being assembled. Fourth, the company was to make comprehensive pollution control in the harbor area a major scientific research topic, and the scientific research departments are currently carrying on specialized studies on this topic so as to make a contribution to the construction of a scenic fishing port in Yantai Harbor.

8480
CSO: 5000/4015

HEAVY METAL CONTENT OF XIANG, PEARL RIVERS STUDIED

Beijing HUANJING KEXUE [JOURNAL OF ENVIRONMENTAL SCIENCE] in Chinese Vol 3 No 1, 28 Feb 82 pp 35-38

[Article by Qu Cuihui [1448 5050 6540] and Zhao Guijiu [6392 2710 0036], Geographical Chemistry Research Laboratory, Institute of Geography, CAS: "Investigation of States of Heavy Metals in the Water of the Xiang River and Pearl River (Guangzhou Section) and a Suggestion on Water Quality Monitoring and Evaluation"]

[Text] Heavy metals are present in surface water primarily in the dissolved and suspended states, which have different behaviors and degrees of toxicity to aquatic life. Accordingly the investigation of heavy metal pollution must deal not only with total quantities, but also with the proportionality between dissolved and suspended forms in order to give a relatively complete evaluation; this is one way of understanding the laws of migration and conversion of heavy metals.

There are two methods of studying the proportionality between dissolved and suspended elements. A relatively precise method is separate determination of filtered water samples and the residue on the filter; a more approximate method is comparison of analysis results for filtered and unfiltered water samples, which has the advantage of simplicity. We used the latter method for our studies and for investigation of water quality monitoring and evaluation.

1. Basic Situation

The Xiang River and Pearl River (Guangzhou section) are located in our country's central and southern subtropical zones respectively and have different water chemistries.

The Xiang River's chemistry is of the C_{II}^{Ca} and C_{III}^{Ca} types (according to the Alekhin classification method) with a pH of 7-8.0 and a total hardness (German scale) of 4-5. Its annual average sand content is 0.102-0.173 kg/m^3.

The sampling points included relatively pollution-free control points on the upper reaches of the river (source of the river at Xing'an in Guangxi, and Laofutou in Hunan), and polluted areas in its middle section (Hengyang, Zhuzhou, Xiangtan, Changsha) and lower section (Zhangshugang). A total of 23 samples were made at 12 sampling points along its 800-kilometer length.

The Guangzhou section of the Pearl River is in its lower, tidal section. Since it is affected by the tides, its chemical characteristic is a higher chlorine content than most fresh water, which varies considerably with the tides, an average sand content estimated as 0.20-0.40 kg/m^3, and a pH generally between 6.6 and 7.0.

2. Analytical Method

After the samples were taken they were immediately pressure- or vacuum-filtered. The filter membrane was first washed with acid; its hole size was 0.45 microns. After filtration, the filtrate was immediately acidified with 1-1.5 mg of concentrated nitric acid per kilogram and stored. The unified samples were stored after being acidified in the same manner.

The cadmium, copper and lead concentrations in the water were determined using a Daojin AA640-13 atomic absorption spectrometer. The zinc content was determined using a Y-2 atomic flame absorption spectrophotometer produced by the Beijing No2 Optical Instrument Plant.

3. Results and Discussion

Two sets of data on heavy metal concentrations in the filtered and unfiltered samples were obtained using the method described above. The metal concentrations in the filtered water were those for the dissolved state, although in reality they included mobile metal ions, metal complexed to organic and inorganic compounds, and metals on organic resins (with diameters smaller than 0.45 microns). The suspended metals were present in the following five geochemical states: 1. adsorbed; 2. bound to carbonate salts; 3. bound to iron and manganese oxides; 4. bound to organic matter; 5. in mineral crystal lattices. When the unfiltered sample was acidified with nitric acid, the pH was lowered from the neutral or weakly basic natural value to a strongly acidic figure of 2. Most of the adsorbed metals and those bound to carbonate salts went into solution, while a certain proportion of the metals bound to organic matter and iron and magnesium oxides were released, and only the metals present in mineral crystal lattices were unchanged. Our determinations for the unfiltered samples included both completely dissolved metals and some suspended metals.

Our results indicated that there was a clear difference in concentration between the filtered and unfiltered samples (confidence level < 0.05). Only a few heavy metal assays in a few of the unfiltered samples exceeded the levels specified for drinking water by the Ministry of Public Health in 1973. For example, the maximum cadmium concentration in the Xiang River was 0.015 micrograms per liter; the maximum lead concentrations for the Xiang River and Pearl River (Guangzhou section) were 0.49 micrograms per liter (at the Zhuzhou sewage outlet) and 0.13 micrograms per liter (Guangzhou) respectively. But the values determined for the filtered water samples (dissolved metals) did not exceed drinking water standards. Investigations indicate that dissolved heavy metals are more easily absorbed by aquatic life than suspended heavy metals, as well as being more toxic and more difficult to remove from the water.

The suspended metals can be removed by such common methods as filtration and flocculation. Accordingly the heavy metal pollution problems in the two river sections studied are easily solved, allowing the water to be used for drinking. It must be pointed out that this country's monitoring procedures involve determination of concentrations in unfiltered water, while many other countries determine concentrations in filtered water; each of the methods has its advantages and drawbacks, which will be discussed in detail below.

Correlation analysis indicates that the total cadmium, copper and lead concentrations in the Xiang River (for unfiltered samples, and likewise below) are very well correlated with the concentrations of the suspended metals, with r values of 0.99, 0.99 and 0.98 respectively. The correlations between the two states of lead, copper and zinc in the Guangzhou section of the Pearl River are also excellent, particularly for lead ($r = 0.98$), with somewhat lower values for copper and zinc ($r = 0.82$ and 0.70 respectively). Such a correlation was not found for cadmium in the Guangzhou section ($r = 0.27$).

The good correlations between total content and suspended state of a metal indicates that as the total concentration of the metal increases the content of the metal in the suspended state also increases and thus that the content of the metal in the dissolved state is relatively stable.

The regression coefficients for suspended metal and total metal content show quantitatively the increase in the former as the latter increases. The regression coefficients for suspended lead and total lead for the two rivers are close to 1 (1.025 and 1.06 respectively for the Xiang River and the Guangzhou section of the Pearl River), indicating that both river sections have a good purification capability for lead. Although the lead content is high in some polluted areas, the content of the dissolved metal remains relatively unaltered. The purification ability for copper is somewhat less: the regression coefficients for the Xiang River and the Guangzhou section of the Pearl River are 0.90 and 0.70 respectively. The smallest regression coefficients were found for cadmium in the Xiang River and zinc in the Guangzhou section of the Pearl river (0.5 in both cases). The regression coefficients for the heavy metals can be ordered as follows: Pb (Pearl River) $\approx$ Pb (Xiang River) > Cu (Xiang River) > Cu (Pearl River > Cd (Xiang River) $\approx$ Zn (Pearl River). This sequence is in agreement with the sequence of pollution levels with the exception of zinc in the Pearl River section, and accordingly the regression coefficients tend to increase as pollution levels increase.

To summarize the foregoing, both of the river sections studied have very strong self-purification capabilities for heavy metals, and most of the heavy metal pollutants are present in the suspended state; the concentrations of metals in the suspended state increase as total concentration increases, while the concentrations of the metals in the dissolved state are relatively stable and never exceed drinking water standards.

4. A Suggestion Regarding Water Quality Monitoring and Evaluation

The water quality monitoring method generally used in our country involves addition of the preservative and performance of the analysis on the water samples without filtering. The sample results are the totals of the more

active portion of the suspended matter and the dissolved metals. Abroad, after the samples are collected they are immediately filtered (generally within 2 to 3 hours) through an 0.45 micron membrane filter, then afterwards the preservative is added and they are stored for analysis. The analysis results give only the concentration of metals in the dissolved state. The United States maximum permissible concentrations of toxic substances in surface water are for filtered water samples. For example, the U.S. surface water standard for public water supplies (1980) specifies that the concentrations of toxic substances refer to "components which cannot be removed by usual treatment methods." The water quality standards of the World Health Organization and of other countries are similar. The maximum concentrations of toxic substances in drinking water specified in the regulations issued by our country's Ministry of Public Health in 1973 are basically similar to those of other countries and the World Health Organizations, but Paragraph 2 of Article 11, Section 3 states that "the quantities of toxic substances in the untreated water must be in accordance with the water quality standards in Article 6 of these regulations." Since there is no amplification we can take this to refer to total content (concentration in unfiltered water samples). Accordingly, our country's standards appear identical to those of other countries but actually differ and are not comparable. But in practice, the standards will inevitably be compared, and accordingly this creates confusion in water quality evaluation.

The two types of standards have their strong points and weak points. The method used in our country is more comprehensive. Under certain conditions the active portion of the suspended material can go into solution. When the suspended material enters the digestive systems of fish, some of it may be adsorbed, and accordingly it must be taken into account in surface water quality evaluation. But it generally can be ignored in evaluating drinking water supplies. The main deficiency of this method is the difference in conditions for different water samples, which means that they are not comparable. Because there can be great variation in suspended matter between two rivers, two sections of the same river, or even samples taken from the same river section at different times, and there are considerable variations in the silt content of the samples, while the amount of preservative (nitric acid) added is the same, the quantities of acid acting on a unit amount of suspended matter are different, and the amount of metal released from suspension will vary accordingly, so that the results will not be comparable. The methods used abroad avoid this deficiency, but they completely ignore the concentration of suspended matter, so that they are one-sided, particularly in evaluating water for fisheries. In reality there are frequently water samples with rather high concentrations of trace metals, but with relatively low amounts in the dissolved state. For example, the total aluminum content and dissolved aluminum content of the Guangzhou section of the Pearl River are 47.9 and 28.9 micrograms per liter respectively in a clean area and 99.5 and 13.9 micrograms per liter in a polluted area. If we consider only the concentration of dissolved metal, we obtain the erroneous conclusions that the content is high in the nonpolluted area and low in the polluted area.

The resolution of this contradiction will require further investigation of water quality analysis, states of toxicants, and their toxicities to aquatic life. Until the problem is resolved, the best approach is to analyze both filtered and unfiltered samples, thereby making use of the strong points of both methods and making the results comparable with international figures.

8480
CSO: 5000/4034

SOIL POLLUTION BY CHLORAL INVESTIGATED

Beijing HUANJING KEXUE [JOURNAL OF ENVIRONMENTAL SCIENCE] in Chinese Vol 3 No 1, 28 Feb 82 pp 47-49

[Article by Xu Ruiwei [1776 3843 5633], Li Xunguang [2621 0534 0342] and Jin Wei [7246 0251], Environmental Protection Office, Nanjing Soil Research Institute, CAS: "Damage to Peanut and Corn Crops from Chloral: An Investigation of a Pollution Incident in Wendeng County, Shandong"]

[Text] In the spring of 1980, Wendeng County, Shandong bought 2,000 tons of calcium superphosphate produced by a phosphate fertilizer plant in X County, Tianjin. This was used in early May as a base fertilizer for spring peanut and corn crops and as a dress for mulberry and fruit trees. Not long afterwards it was discovered that the crops in the fields where this fertilizer had been applied were abnormal, the leaves were shriveled, stuck together, wrinkled and curled, some stalks had withered, some of the plants had rotted seeds, and some shoots had died. At first it was erroneously thought that the cause was a plant disease or insect pest, and insect control measures were applied to the less affected plants, while those seriously affected were destroyed and the fields sown again, but the results were still poor, and in some places the same symptoms recurred on two or three subsequent sowings. The affected area was more than 40,000 mu and the affected crops were peanuts, soybeans, corn, paddy rice, sweet potatoes, radish, mulberry trees, fruit trees and the like. The seriously affected crops produced no harvest at all, and the economic damage was estimated at several million yuan, in addition to which the masses' production enthusiasm was dampened. In mid-July we made an analysis of phosphate fertilizer and soil samples from the area and discovered that the phosphate fertilizer contained 6,000 ppm of chloral residues, while the soil samples had a content of 10 ppm. In order to further investigate the reasons for damage to the crops and to determine possible effects on the fall wheat crop, in mid-September of the same year we went to Wendeng County for an on-the-spot investigation, involving visits to five brigades in three communes in which we observed and surveyed the symptoms shown by crops in some of the affected fields and analyzed 104 soil samples from some of the fields and the phosphate fertilizer remaining in the soil; in addition we sampled and analyzed leftover superphosphate from the same batch which the affected brigades in the province still had on hand. The Wendeng County Scientific and Technical Committee and the Agricultural Office also carried out experiments with peanut and corn plants grown in pots. The investigations and experiments showed that this was another case of serious pollution of

agricultural land and poisoning of crops by chloral, and that the direct cause was the excessive chloral content of the phosphate fertilizer.

1. Chloral is an important intermediate in organic synthesis and is used to produce many chemical engineering products and agricultural pesticides. The process stage in which chloral is purified produces chloral-containing waste sulfuric acid and wastewater. Many local phosphate plants use this waste acid to produce calcium superphosphate, so that chloral is present in the fertilizers and accordingly is shipped to many locations. It was found that the starting material for this batch of fertilizer included waste acid from a chemical engineering plant in Tianjin which contained a rather large quantity of chloral; because the relevant departments did not understand the chloral could do serious harm to crops, they used the waste acid to manufacture fertilizer.

Chemical tests on many samples of leftover phosphate fertilizer taken from certain production teams in Wendeng County showed that when it was stored in heaps outdoors, after 4 months the fertilizer still contained 1,000-3,000 ppm of chloral, indicating that the original chloral content of this fertilizer was even higher and that when applied to crops it could not fail to do serious harm.

Our past research had made it clear that when acted upon by soil microorganisms, chloral can be converted rapidly into trichloroacetic acid, which has serious effects on crops and can remain in the soil for rather long periods (70-100 days). If supplementary sowings or new sowings are made during this period, the crops will continue to be damaged by the trichloroacetic acid. Environmental conditions (such as soil characteristics, precipitation, temperature and soil moisture) will affect its rate of degradation. In general, higher soil moisture, more rainfall and higher soil temperatures help in the degradation of chloral and toxic residues. When we analyzed two soil samples from Wendeng county in July, the chloral content was 10 ppm, indicating that the soil still contained considerable toxic residues from fertilizer application 2 months before and that the reason that resowings and supplementary sowings had been damaged was the dry weather, low air humidity and low soil moisture. In the middle of September we took 104 soil samples from the affected fields and detected no residues. This was because from July to September there had been high temperatures and several rainy spells, speeding up the decomposition of the chloral in the soil. We were able to predict that the fall sown crops would suffer no damage.

2. On-the-spot observations and surveys indicated that the main symptoms of crop damage in Wendeng County were serious suppression of growth, wrinkling, malformation and a deep green color in the leaves, swelling of stalk nodes, and dwarfing of the plants. These symptoms were in agreement with the known effects of chloral and trichloroacetic acid on crops, and were also in agreement with the pot culture experiments with chloral that had been performed by the Wendeng County Scientific and Technical Committee's laboratory. According to botanical documentation, chloral produces cell division disorders and disrupts the cells' polar structure and differentiation, producing abnormal structures, hindering normal development, and causing death in serious cases. Field investigations indicated that the degree of damage to

the plants was related to the quantity of fertilizer applied; application of 70 kg per mu already produced clear symptoms, while applications of 100-150 kg per mu destroyed most of the crop and there was still serious poisoning when the sowing was repeated. The specific symptoms shown by various crops are described below.

A. Peanuts. Seriously affected plants did not germinate; those moderately affected generally germinated but the plants were stunted, the new leaves stuck together, the leaf surface areas were small, the leaf material was thickened and the color was deep green, while stalk growth was seriously suppressed, the main root was fleshy and swollen and no flowers were produced. When the toxic effect was mild, the leaves were dark green, clumps of branches appeared at the base of the stalk, the main root was fleshy and swollen, the number of flowers was small, development of the pegs was retarded, there was little or no fruiting, most of the shells produced contained no seeds, and the plant was a whole had a languishing appearance.

B. Soybeans. Seriously affected soybeans did not germinate. Those affected to an intermediate degree showed serious leaf wrinkling and a dark green color, there was no flowering, and the entire plant had a languishing appearance. In those slightly affected, some of the leaves became wrinkled and all of the leaves were deep green, there were few flowers, and either no shells or empty shells were produced.

C. Corn. In seriously affected plants the growth of the seedlings was seriously suppressed, the new leaves were badly wrinkled or curled and the leaves were dark green and gradually withered, after which the plant itself withered and died.

In cases of moderate damage, the leaves were wrinkled and curled lengthwise into a tubular shape or transversely into a trumpet shape, the bases of the stalks were twisted and curved, the ears were small and deformed, development was retarded, there was little root development, and the plants were dwarfed. In mildly affected plants, the two first leaves stuck together in a funnel shape or rolled up longitudinally in a tubular shape, and the plants were dwarfed.

D. Paddy rice. In seriously affected plants, the central leaves were curled, shrunken, whitened and withered, or the blades and sheaths of the older leaves showed brown stripes or spots and gradually turned inward, finally dying. In moderately affected plants, growth was seriously suppressed and there was little tillering, the leaves were deep green with withered patches; there generally was no earing and the plants were dwarfed. In mildly affected plants, there was tillering but the ears were generally unproductive, there were many blighted grains, and the yield was greatly decreased.

E. Sweet potatoes. In seriously affected plants, growth stopped in the seedling stage, or the leaves were wrinkled, shrunken, thickened, and dark green, the stalks were fleshy and swollen at the nodes, the leaf stalks were short, the tubers were small and thin, and the vines were sparse and short. In mildly affected plants, the leaves were wrinkled, shrunken and deep green and yields were greatly diminished.

F. Radishes. The leaves were wrinkled and shrunken, and plant and root development were suppressed.

G. Apple trees. In the initial stage of poisoning, most of the leaves fell, and those which remained curved downward, while fresh leaves were wrinkled and shrunken and there were few fruits.

H. Mulberry trees. In seriously affected mulberry trees, most of the leaves were wrinked and shrunken and sharply pointed and badly curled. Their color was deep green and their longitudinal and transverse growth was seriously suppressed, while the entire tree was stunted and clumps of new branches appeared on branches and small twigs. In mildly affected trees, the new leaves showed relatively marked wrinkling and were deep green. The damaged and wrinkled leaves caused the death of fourth-stage silkworms fed on them.

3. In the past 10 years there has been case after case of serious chloral pollution of the environment and damage to agricultural production. In the early 1970's there were many instances in which chloral polluted water sources and harmed large wheat acreages in Beijing, Tianjin, Zhengzhou, Xi'an and Zibo. In 1974 an area of more than 60,000 mu was polluted in the Ji Canal area of Tianjin, with a loss of 10 million jin of grain. In the mid 1970's, because many local phosphate plants could not get an adequate supply of regular sulfuric acid, they used chloral-containing waste sulfuric acid as a starting material, producing chloral-polluted fertilizer which harmed large crop acreages in Zhejiang, Jiangsu, Shandong, Liaoning and Hebei. For example, use of this polluted fertilizer in Tai County, Jiangsu in November 1979 caused damage to 6,000 mu of wheat and a loss of a million jin of grain. Such instances of pollution are widespread in our country and the threat to agricultural production is great, so that it should be taken seriously by the relevant departments.

Utilizing the three wastes and "changing waste into treasure" is unquestionably a correct policy, but stress must be laid on a scientific approach and blind action must be stopped. Chloral-containing wastewater and waste acid must be treated to decrease the chloral content to permissible levels before it may be discharged or used. When waste acid is used to produce phosphate fertilizer, the starting material must be stringently tested and the amounts of chloral and other harmful substances must be monitored. Units which knowingly discharge polluted water or sell waste acid or fertilize products containing excessive quantities of chloral must have their responsibility determined in accordance with the state environmental protection law.

Much investigation has been conducted in this country on the nature of chloral as a pollutant, the character of the pollution process, symptoms of crop damage and protective measures, and many results have been obtained. We hope that the cognizant departments will organize manpower, carry out widespread propaganda and take effective measures to prevent continued occurrence of such incidents.

8480
CSO: 5000/4034

RADIATION POLLUTION FROM COAL STUDIED

Beijing HUANJING KEXUE [JOURNAL OF ENVIRONMENTAL SCIENCE] in Chinese Vol 3 No 1, 28 Feb 82 pp 49-53

[Article by Ye Chongkai [0673 1504 7030], Li Wangsheng [2621 2489 3932], Qian Weicheng [6929 0143 2052], Zhou Wenqin [0719 2429 3832] and Liu Xiaosong [0491 2556 2646], Research Institute of Industrial Health, Jiangxi Province: "Radiation Pollution of the Environment by Coal"]

[Text] The burning of coal is causing serious environmental pollution. The chemical and biological damage caused by wastes from coal is now rather well understood, but the harm done to the environment by radioactive pollution has not yet attracted widespread concern. There is a dearth of data and only a small literature on radioactive pollution resulting from coal. In this article a determination of the radioactive content of coal and on-the-spot surveys of coal extracting and coal-burning units are used to cast light on radioactive pollution caused by coal.

1. Determination of the Radioactive Components of Coal

Sources of data. The raw coal samples were taken from Anyuan coal, Juyuan coal and Qingshan coal from the Pingxiang coal mine in Jiangxi, which has been in operation for nearly 100 years, and from Fengcheng coal and Xinhua coal from another major coal field in Jiangxi. The coal samples were collected and made available to us by the mines' production quality control departments using a method described in the literature. A method from the literature was also used to eliminate extraneous moisture and to prepare dry coal as called for by the standards.

Method of determining content of radioactive substances. The dried coal samples were reduced to coal ash. Samples weighing 0.5 g were subjected to radiochemical separation and the purified samples were made into beads with sodium fluoride and the fluorescence method was used to determine the uranium content. Two-gram samples of the ash were subjected to radiochemical separation and purification and a radonthorium analyzer was used to determine radium-226 content by the radon method.

The results indicate that there are slight differences in the uranium and radium-226 contents of raw coals from the five major Jiangxi coal mines; the

uranium content range was 0.89-4.40 micrograms per gram of coal with an average level of 2.40±0.66 micrograms per gram; the radium content range was 0.28-1.38 picocuries per gram of coal and the average was 0.92±0.18 picocuries per gram. The variation in radium-226 content among the five coals did not exceed an order of magnitude. These values were similar to the uranium and radium-226 contents of reported in U.S. and British coals; the uranium content of U.S. Illinois coal was $1.5\pm0.93 \times 10^{-6}$ g/gram of coal, that of western U.S. coal $1.2\pm0.65 \times 10^{-6}$ g/gram of coal, that of Appalachian coal $1.5\pm0.73 \times 10^{-6}$ g/gram of coal, and the radium content of Biliedian [phonetic] coal (UK) was $0.05\text{-}0.3 \times 10^{-12}$ curies/gram. The concentration of radioactive matter in coal varies with the nature of the starting material involved in the coalification process and the complex processes of percolation and deposition of radioactive elements among the various buried strata. Because the starting materials for the coals differed, and the plant detritus accumulated under different conditions and the strata were subjected to differing underground water regimes and underwent complex physical, chemical and geological development, there are variations in the radioactivity content of the coals. Some coals associated with natural uranium ores have high uranium concentrations, even to the point of being extractable uranium ores; and the coal ash and cinders remaining after the combustion of some coals also have a high uranium content.

Natural uranium occurs in the environment in the hexavalent state. It is amphoteric; under acidic conditions it occurs as easily-soluble uranyl cations, while under basic conditions it occurs in difficulty soluble diuranate anions. In general, all environments in which uranium occurs also contain radium. Subsurface water in some mining districts has a rather high radium content, and the soluble radium salts ($Ra(OH)_2$, $RaCl_2$, $RaBr_2$, $Ra(NO_3)_2$ and the like) can be eroded by subsurface water and dispersed in natural waters. But what is the solubility of uranium and radium contained in coal? We carried out the following investigation of this question.

Under laboratory conditions, 200 g of standard dried raw coal was extracted with deionized water for 10 days in a crucible, and all of the extraction water was filtered and a uranium and radium-226 determination made.

The results indicated that the extraction liquids from the five varieties of Jiangxi coal were weakly acidic; uranium and radium-226 were found in all of them, but the amounts extracted were rather low. This indicates that like natural uranium and radium, the uranium and radium in the coal are soluble to some degree under acidic conditions; this is an important datum with regard to radioactive pollution of water sources by raw coal.

We also determined the solubility of uranium and radium in coal ash.

The results indicated that the extraction fluid was also weakly acidic, and the quantities of uranium and radium-226 which it contained were slightly higher than the extract from the raw coal, indicating that the uranium and radium salts which remained after removal of the organic matter from coal by combustion were readily soluble, and as a result wastewater that had been in contact with coal ash has a relatively high uranium and radium content.

But in order to determine the relationship between the length of immersion and the quantities extracted we carried out comparative tests.

These tests indicated that the percentage of the radium in coal and coal ash that was extracted was somewhat related to the time of immersion; 3 days or more was required for raw coal and 10 days or more with coal ash before a relatively large proportion was extracted. But after 30 days soaking there was no apparent further increase in the quantities extracted, indicating that soaking of raw coal for 3 to 10 days and of coal ash for 10 to 30 days resulted in solution of virtually all the soluble radium salts. Regardless of the soaking time, the percentage extracted from the ash was nearly 10 times as high as that extracted from raw coal, which is the main reason why water contaminated by coal ash produces radioactive pollution of the environment.

2. Surveys of Radioactive Pollution of the Environment by Coal.

Radioactive pollution of the environment by coal is produced primarily by wastewater from water-curtain dust removal of ash in smokestacks and water from the washing of furnace ash, by coal-pit water and coal classification water from mines, and by water percolating from coal stored outdoors which is wet by precipitation. We conducted uranium and radium-226 determinations of wastewater from coal-burning electric power plants and from a coal classification plant. Uranium was determined in a 1-liter sample of water, and radium-226 in a 10-liter sample. Surface water samples were used as controls.

The results indicated that both coal-ash wastewater and coal classification wastewater were capable of producing radioactive pollution of environmental water sources. The uranium content of the wastewater from the power plant was as high as $7.0 \pm 0.70 \times 10^{-6}$ g/liter, about 20 times as high as for the control sample; the radium-226 content was $2.52 \pm 0.75 \times 10^{-13}$ curies/liter, about 15 times as high as for the control sample. The power plant in question discharges 9,600 tons of wastewater a day, and accordingly it is estimated that it discharges 67.2 grams of uranium a day or 24.5 kg a year and 24.2×10^{-7} curies of radium-226 a day or 8.8×10^{-4} curies a year into the river. The uranium content of the coal classification plant wastewater was $1.86 \pm 0.15 \times 10^{-6}$ g/liter, about 6 times as high as in the control sample, and the radium-226 content was $2.24 \pm 0.17 \times 10^{-13}$ curies/liter, about 13 times as high as in the control sample. Since this plant discharges 300 tons of wastewater a day, it is estimated that it discharges 0.56 grams of uranium a day or 204 grams of uranium a year and 6.72×10^{-8} curies of radium-226 a day or 2.5×10^{-5} curies a year into the local streams. With this continuing discharge of wastewater into streams, radioactive pollution of water sources cannot be ignored.

In the power plant's coal storage yard, the uranium content of acidic (pH 4-5) water taken from the most surrounding the coal pile was 1.06×10^{-5} g/liter, about 32 times as high as for the control sample (0.33×10^{-6} g/liter), while the radium-226 content was $1.46 \pm 0.02 \times 10^{-13}$ curies per liter, about an order of magnitude higher than in the control sample.

The uranium content of well water in the vicinity of a certain coal mine (the well water at the classification plant is used in classification) was $1.20\pm0.10 \times 10^{-6}$ g/liter and the radium-226 content was $1.18\pm0.3 \times 10^{-13}$ curies per liter, both of these values being higher than for the control samples.

The degree of radioactive pollution of water sources by coal does not exceed state standards (0.1 mg/liter for uranium and 3×10^{-11} curies/liter for radium-226), but if wastewater is continuously discharged into the streams over a long period, it must inevitably degrade water quality and produce pollution.

3. Survey of Radioactive Pollution of the Atmosphere by Coal

Radioactive pollution of the atmosphere by coal results primarily from coal gas discharged from the smokestacks of plants burning coal and from the use of fire to dry coal in classification plants, as well as from smoke and ash emitted during household coal burning.

We surveyed radioactive pollution of the surrounding air by smoke and ash emitted from the smokestacks of a coal-fired power plant. The method was as follows. A point 2500 meters downwind of the smokestack was used as the polluted area sampling point (the maximum concentration of toxic gases is located at a horizontal distance 25-35 times the height of the smokestack). A location 5,000 meters upwind of the smokestack was taken as a nonpolluted control sampling point. This was located in suburbs or in the countryside with no smokestacks nearby. It also was free interference from city smoke. When weather conditions were essentially the same, sampling was carried out every day at 9-10 AM; the atmospheric samples were taken at the same time in the polluted and nonpolluted regions at a height 1.5 m from the ground (i.e. the height of the human respiratory apparatus), and the radioactive content of randon products, which are decay products of uranium and radium, was determined.

The results indicated that the radon product radioactivity concentration was higher in the downwind polluted region than in the upwind control region. The average concentration in the polluted region was 511.2 ± 68.8 MeV/liter, about twice as high as in the control area (average 286.8 ± 14.3 MeV/liter). The difference between the measurements in the polluted and nonpolluted regions was clearly significant, with a confidence limit of $p < 0.01$. In addition, the concentration in the polluted area exceeded the radioactivity protection standard for the general population, i.e. 400 MeV/liter. The readings in the control location were relatively constant, representing the natural background level. In the polluted area there were slight variations depending on wind speed. All readings in the polluted area were higher than in the control region, confirming that they resulted from pollution by the power plant. Because the uranium and radium breakdown products in coal gas are capable of being discharged from the smokestack into the air in the form of a radioactive aerosol, they can enter the body through the respiratory organs. An adult breathes approximately 20,000 liters of air a day, and a person in the polluted area would inhale a considerable quantity of radon and

radon products. Of the environmental factors currently thought to be related to lung cancer, most attention is focused on three, namely smoking, atmospheric pollution, and occupations involving dust and toxic gases. The harm which coal smoke and gas cause to the human respiratory apparatus has been confirmed.

In addition to atmospheric pollution produced by industrially used coal, the local air pollution produced by domestically used coal should also be considered; the small stoves dispersed through a multitude of households and the short chimneys in residential areas are an important source of pollution by coal ash. It is estimated that a ton of coal in dispersed domestic use produces 1-2 times more smoke and ash than a ton in concentrated industrial use and 3-4 times as much flyash, and in winter in particular, more coal is used for home heating than in industry and large quantities of coal dust fill the air of the residential districts, causing great harm. We took random samples in certain residential districts, determining the radon product content of the air in kitchens and bedrooms, and made the same determination for the outside air as a control.

The results indicated that the radon product concentration in residences was in the following sequence: kitchen > bedroom > outdoors. The kitchens and certain bedrooms had radon product concentrations in the air which exceeded the permissible level for the general public (400 MeV/liter). The main reason for the high concentration of radon products was the use of coal for cooking and the fact that housing construction did not meet residential ventilation requirements.

4. Survey of Environmental Radioactive Pollution Caused by Coal Ash and Cinders

Among coal wastes, coal ash and cinders are a major source of radioactive pollution. Currently, in the process of comprehensive waste prevention and recovery, new uses have been found for ash and cinders. For example, they are used as a starting material in the production of cinder block and cinder concrete; coal ash and cinders with high potassium, calcium, phosphorus and magnesium content may also be applied directly to agricultural land as a fertilizer. But the radioactive materials in ash and cinders have not been removed and are disseminated into the environment by the manufactured products. Under the action of water, some of the radioactive materials contained in ash and cinders or products made from them can be dissolved, for water is an excellent solvent. The ash can pollute not only water but the air as well, because the radioactive decay products radon and thoron [radon-220] can be dispersed into the atmosphere. We determined the concentrations of uranium and radium-226 in coal ash and in cinders.

There was some differences in the uranium and radium-226 contents of cinders and ash from the five types of raw Jiangxi coal. The average uranium content of the ash and cinders was $2.48 \pm 1.21 \times 10^{-5}$ g/per gram of ash, while the radium-226 content averaged $3.89 \pm 0.5 \times 10^{-12}$ curies per gram of ash. The latter figure

is in full agreement with the radium-226 value for Appalachian coal ash of $3.8\pm0.4 \times 10^{-12}$ curies per gram given by Eisenbud.

5. Conclusions

The toxicity produced by radioactive pollution of the environment originating in coal is many-sided. The radioactive substances in coal act on the human body from the biosphere by many routes. The biologically most significant radioactive compounds in coal are uranium and radium and their decay products radon and the radon products polonium-210 and lead-210.

In the book "The Danger of Radioactivity in the Environment," J.G. Gofman points out that in ionizing radiation almost certainly causes various types of human cancers. Twenty years' research indicates that if radioactive energy encounters a sensitive cell it can produce cancer in any organ. The question of how much harm radioactive pollution of the environment caused by coal may do by exposing the human body to radioactive substances is an extremely complex one: it is the question of the harm done to the human body by small doses of ionizing radiation. There is as yet insufficient information to reach a correct conclusion on this question.

There is no agreement on whether there is a threshold dose above which ionizing radiation poses a danger of malignancy or on what the effect of such a dose might be. For the purpose of radiation protection, the International Radiation Protection Committee has adopted the hypothesis that there is a linear relationship between dose and effect and no threshold dose, and that the dose effect is cumulative. Accordingly our investigation of radioactive pollution of the environment caused by coal has extremely great biological and public health significance.

8480
CSO: 5000/4034

ATMOSPHERIC CAPACITY FOR FLUORINE COMPOUNDS INVESTIGATED

Beijing HUANJING KEXUE [JOURNAL OF ENVIRONMENTAL SCIENCE] in Chinese Vol 3 No 1, 28 Feb 82 pp 73-76

[Article by Wan Guojiang [8001 0948 3068] and Xu Yifang [1776 5030 5364], Research Institute of Geochemistry, CAS: "An Analysis of the Environmental Capacity for Atmospheric Fluorine in China"*]

[Text] The basic goal of research on the geochemical behavior of harmful substances in the environment is to elucidate their evolution in the environment and provide basic data for effective control of environmental quality. Differences in natural environmental conditions complicate the solution of this problem, but regional variations in natural environmental conditions follow traceable patterns, making environmental forecasting possible to some extent. Accordingly, we propose to study the manmade discharge of harmful substances into specific environments in order to determine their environmental geochemical behavior and local differences in natural environments, and to use specific surveys to find the capacities for various environmental materials under various regional environmental conditions and conduct an analysis of these capacities as a precondition for a comprehensive delineation of regions.

Industrial fluorine compounds stand out in terms of both the quantities discharged and the harm they do to the environment. Accordingly, an investigation of the environmental capacities for industrial fluorine compounds has become the first stage of our work.

1. Discharges of Fluorine into the Atmosphere and Their Geochemical Behavior

The main types of manmade discharges of fluorine into the environment result from thermal decomposition, acidic decomposition, hydrolysis and mechanical dispersion.

A considerable body of research makes it clear that although discharge of fluorine ions into water environments products a cumulative effect under natural background conditions, regional environmental variation is not of

*This paper was prepared under the guidance of Mr Liu Dongsheng [0491 2639 3932], Comrade Yu Zhicheng [0151 1807 2052] helped prepare the graphics, and Comrade Sheng Naixian [4141 0035 6343] gave enthusiastic assistance; we take this occasion of thanking them.

major importance. Although fluorine in silt and soil participates to some extent in biochemical processes, because it is present in crystal lattices and in adsorbed form, it is environmentally rather inert and does not play a major role in environmental fluorine variations; but gaseous fluorine compounds such as HF and SiF_4, which can be dispersed by the air, have a wide range of effects and are highly toxic, have a rather pronounced effect on the human body and biological organisms, so that they occupy a special place in geochemical analysis of variations in environmental fluorine. Accordingly, this analysis must first take account of variations in fluorine in the atmospheric environment, and the highly toxic HF and SiF_4 are the gaseous fluorine compounds whose occurrence must be particularly considered.

Gaseous molecules of hydrogen fluoride are stable but polymerize easily, forming chain polymers such as $(HF)_2$, $(HF)_3$ and the like. At 20° and a pressure of 745 mm of mercury, 80 percent of HF molecules exist in this polymerized form. Hydrogen fluoride is readily soluble in water (at atmospheric pressure and 20°C the solubility is 35.3 percent), but because of its low ionizability, it is not highly acidic; when silicon tetrafluoride encounters water it decomposes into silicid acid and fluorosilicic acid. This characteristic dictates that during atmospheric precipitation both HF and SiF_4 easily pass from the atmosphere to the water environment, which lessens their environmental variability and harmfulness and tends to remove them.

2. Analysis of the Variability of Environmental Quality in Terms of Fluorine

We estimated emission rates (kg/hour or tons/year) and calculating the percentages of global emissions recorded by individual research units; when we proceeded to a geochemical analysis of the environmental avariability caused by industrial fluorine emissions, we took account of the following points.

1. State of occurrence. We considered that the investigation should focus on environmental conditions and states of occurrence of the highly toxic, large-environmental-effect gaseous compounds such as HF and SiF_4.

3. Form of emission. The size of the effect of spatial location of the emission point and height of the smokestack on environmental effect is correlated with environmental effect and a conversion is made to effective discharge for low smokestacks.

4. The effect of local atmospheric diffusion conditions. Atmospheric diffusion and dilution decrease the effective concentrations of harmful substances.

F.A. Gifford et al. hypothesize that atmospheric pollutant concentration is inversely proportional to average wind speed; W.O. Shults et al. hypothesize an index (either individual indices for individual compounds or an overall index) which, like the pollution concentration, should be inversely proportional to wind speed. Accordingly, we can use these relationships in analyzing the environmental variation in produced by gaseous fluorine compounds.

5. The effect of local environmental pollutant degradation conditions. As indicated by the analysis made above, local breakdown of HF and SiF_4 is closely related to precipitation, and accordingly we assume that the local fluorine environmental variation coefficient is inversely proportional to the local proportion of global precipitation.

On the basis of the foregoing, we set up the environmental variation coefficient P for a unit's fluorine measurements:

$$P = f(\rho, k_x, k_d, k_h) = \lg(\rho k_x / k_d k_h)^{\frac{1}{2}}$$

Here ρ is the proportion of total environmental fluorine accounted for by the unit's measurement of fluorine discharge (i.e. the ratio of the local discharge rate to the global discharge rate); k_x is the coefficient of effective fluorine discharge for the unit (i.e. the ratio of the adjusted discharge rate, with allowance for type of emission, state of occurrence and type of discharge, to the raw discharge rate); k_d is the global gradient of the atmospheric diffusion capability for the location in question (i.e. the ratio of the average wind speed for that location to the worldwide average continental precipitation); and P is the environmental variation coefficient obtained for the research unit in question through geochemical analysis; by substituting the research unit's relevant data into the formula, the fluorine environmental variation coefficient can be calculated.

3. Correlation Analysis of Fluorine Environmental Variation Coefficient

The degree of environmental harm done by pollution may be reflected in biochemical indicators in plants and animals, in human health, or in economic losses. In general terms, the environmental quality variation coefficient is positively correlated with the degree of harm, but the nature of the effect will vary with the nature of the specific area in question (agricultural, livestock raising, residential and the like). The case is similar for economic losses. But in areas which do not differ greatly in their degree of economic development, economic losses should also be correlated with the environmental quality variation index.

Can the fluorine environmental variation indices obtained on the basis of the geochemical analysis described above reflect the real degree of pollution?

An analysis of the correlation between the environmental variation indices for 10 fluorine emitting plants in certain districts and the environmental harm produced gave a correlation coefficient for the environmental variation index P and the degree of environmental harm Y equal to $r = 0.835$.

Using the Fisher Z transformation method we obtain $t = 3.19 > 1.96$.

Thus there is a clear positive correlation between the fluorine environmental variation index P and the degree of environmental harm Y. The regression formula is $Y = 1.41\ P + 0.38$.

This is a linear empirical formula for the relationship between the fluorine environmental variation index and the degree of environmental harm.

The point scatter and regression line are shown in Fig. 1.

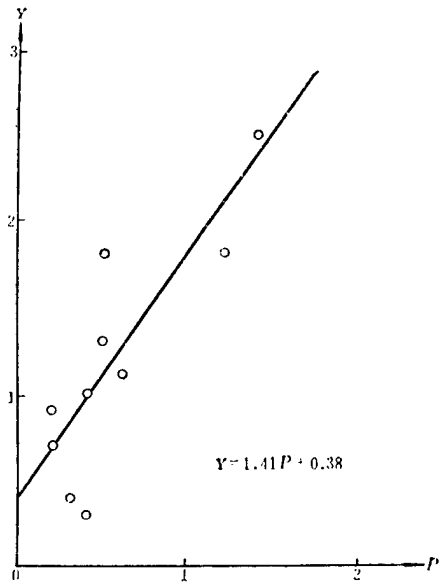

Fig. 1. Point scatter and regression line for relationship between degree of environmental harm and environmental variation index.

These results indicate that the environmental variation index model proposed in this article is fully usable to describe the degree of fluorine pollution. Thus we can use various units' fluorine environmental variation indices to draw a nationwide fluorine pollution map. Comparing the environmental variation index obtained from geochemical analysis of environmental variation with the ordinary environmental quality index obtained from monitoring data, although they both can be used to describe the real degree of pollution, the environmental quality index must be worked out from a large amount of monitoring data, while the environmental variation index is based only on calculations with discharge quantities and use of the diffusion and purification laws for harmful substances under specific environmental conditions. The comparison indicates that the method described here not only is applicable to estimating the degree of pollution resulting from a given plant's emissions, but should have even greater real significance in analyzing environmental capacities, developing rational regional emissions standards, and rational geographical distribution of industry.

4. Industrial Atmospheric Fluorine Environmental Capacity Regions of China

Using the empirical formula given above, we not only can forecast the degree of harm done by fluorine emission sources, but also are better equipped to investigate the fluorine capacity under various environmental conditions.

If on the Y-P regression formula the degree of environmental pollution Y is set at zero, we obtain the environmental variation coefficient which produces no environmental harm (the environmental critical value), which is -0.27.

We understand the significance of environmental capacity as being the maximum permissible rate of discharge of a given harmful substance by a given source in a given environment which, because of environmental effects, will produce no environmental harm. Obviously the environmental capacities for a given substance in different areas will vary with their environmental conditions.

Using the environmental conditions of different regions of our country, and taking the environmental critical value of -0.27 for industrial emissions of fluorine our country as a base figure, we calculated the permissible discharge rates for 486 areas of our country (in kg/hour). After constructing a map, we took account of differences in environmental geological conditions and interpolated to construct isometric lines, obtaining a map of industrial fluorine atmospheric environmental capacity regions.

Using the isometric lines we can divide the country into five fluorine capacity regions.

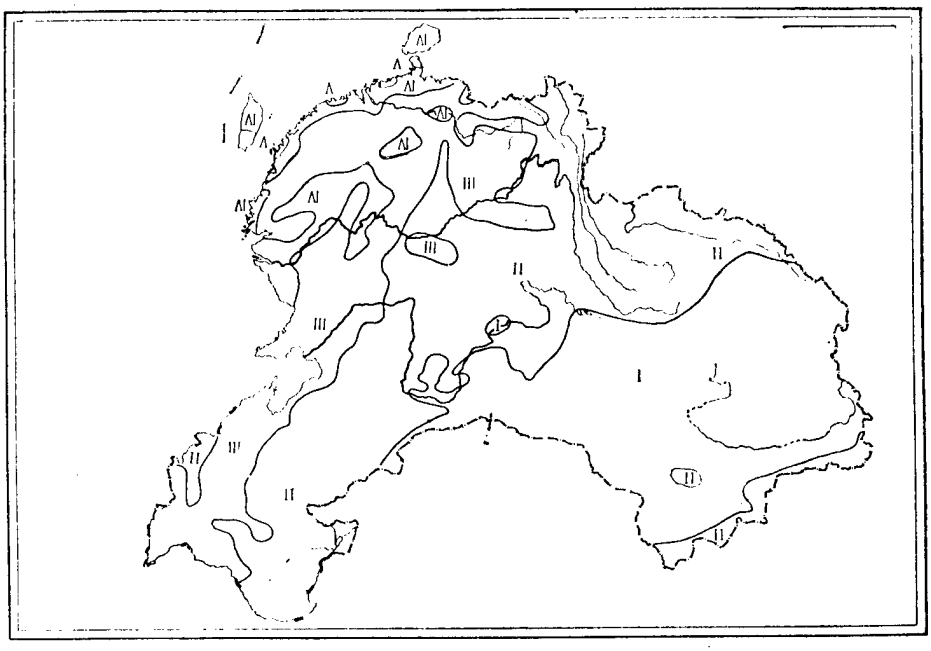

Fig. 2. Atmospheric fluorine environmental capacity regions of China

The fluorine capacity map furnishes basic data for rational geographical distribution of fluorine-emitting enterprises, for setting control requirements for fluorine-emitting enterprises, and for forecasting the extent of fluorine pollution.

In using the atmospheric fluorine environmental regions we have derived we must take account of several factors.

1. This division into regions was based on summary environmental data, but because of local variations in environmental geological conditions, there may be small low-capacity areas in high-capacity regions and small high-capacity areas in low-capacity regions. Accordingly, when laying down principles for the siting of fluorine-emitting enterprises, we must take full account of the effect of specific local environmental conditions on the capability for diffusion purification of atmospheric fluorine emissions.

2. The suitability of environmental conditions for construction of fluorine-emitting enterprises is not fixed and unchanging; if setting relatively large emissions proves to be consonant with environmental capacities, fluorine-emitting enterprises may be built in low-capacity regions as well. Conversely, there will be some environmental harm even in high-capacity regions.

3. This division into regions is based solely on environmental geological considerations and does not take account of the degree of development of human economic activity; when it is used for regions where environmental harm can be ignored, the division into environmental capacity regions need not be a constraint.

4. When this division into regions is used in defining local discharge standards for different regions, the following formula may be used for calculations:

$$Q_{h\ \text{standard}} = QH^2 \times 10^{-3},$$

where $Q_{h\ \text{standard}}$ is the emission standard for a given elevation (kg/hour), Q is the environmental capacity for the region in question (kg/hour), and H is the elevation at which emission takes place (meters).

8480
CSO: 5000/4034

ENVIRONMENTAL PROTECTION WORK AT CHEMICAL FIBERS PLANT DESCRIBED

Beijing HUANJING BAOHU [ENVIRONMENTAL PROTECTION] in Chinese No 1, 1982 pp 9-10

[Article by Shanghai No 11 Chemical Fibers Plant: "How Should We Approach Environmental Protection Management?"]

[Text] The Shanghai No 11 Chemical Fibers Plant produces resin-impregnated nylon 6 tire cord fabric; its annual output is 5,400 tons, and it consumes nearly 6,000 tons of caprolactam annually, as well as almost 700 tons of the main accessory materials, oils, resins, anti-aging additives, adipic acid and the like. Its entire production activity includes 13 processes, 10 of which produce wastes. Its output of toxic or harmful wastewater is 115.6 tons a day, of which 112.6 tons per day, or 97.4 percent of the total, has been treated and meets discharge standards. Waste gas discharges amount to 2.036 million cubic meters a day, almost all of which is treated. The caprolactam and chromic acid and other substances which they contain are recovered and used, and an annual total of 241.86 tons of solid waste, all treated, is produced. In 1980 all environmental protection work improved compared with 1979. The proportion of discharged wastewater meeting standards (PH) was 100 percent, oxygen consumption (OC) was 97.22 percent, the average caprolactam content of waste gas was 9.48 mg/m^3, slightly more than half the 1979 figure, and the percentage of gas discharged that met standards was 87.42 percent, up 13.27 percent from 1979. At the same time, 306.85 tons of caprolactam was recovered from extraction wastewater and reused as a raw material; it had a value of 2.3 million yuan and saved US $300,000 in foreign exchange (because all of the starting materials our plant uses are imported). In 1980 we were cited as one of Shanghai's most advanced units in environmental protection. Our insights on effective environmental protection are described below.

1. Improve Understanding, Strengthen Leadership

By publicizing and studying the environmental law, we gave all plant employees some understanding of it; while working hard on production they also did effective work in waste treatment and environmental protection. In March and April 1981, in accordance with our plant's specific situation, we set aside a period of time for concentrated environmental propaganda and for presentation of our own plant's pollution control situation and related knowledge. Thus everyone had a basis of knowledge for further performance of environmental protection work in the plant. On this basis we strengthened

leadership and the plant's headquarters set up an environmental leadership group headed by a deputy plant director whose duties had included responsibility for environmental work. The group was composed of the shop superintendents and relevant personnel from the medical office, the labor protection unit, the equipment department, the technical department, the research office, the supply and marketing unit and the general services department. The research office is a specialized environmental protection department which has three technical personnel specifically engaged in environmental-protection scientific work in addition to two monitoring personnel who carry on regular monitoring and crash monitoring of new projects. In addition, all of the shops set up waste control groups for all special projects. The plant's environmental protection leadership group meets once a month and disseminates and implements environmental policies and directives of the state and the higher-level organizations, monitors implementation of resolutions from the previous meetings, analyzes the plant's environmental protection situation, and drafts approaches for the next stage of work; the plant director is responsible for overall arrangements and decisions on matters brought up at the meetings, and he designates departments and organizes personnel to deal with problems by set deadlines; and monitoring personnel are assigned schedules for monitoring pollution control performance. The result is that waste control work is all carried out systematically and in planned fashion.

2. Investigation to Determine the Situation

In order to gain a full knowledge of the plant's pollution situation, all wastewater flow in the plant was traced and maps of underground piping were used to find the four main wastewater discharge outlets. Then water quality surveys were made of 19 wastewater lines which fed the discharge outlets, a comprehensive analysis was made, a water quality breakdown was obtained, and the water volumes and actual pollution levels were determined in order to ascertain which wastes could be discharged, which were only slightly polluted, and which were seriously polluted. Finally, using the water quality and quantity data and taking note of the plant's specific situation, rational measures were adopted and comprehensive utilization approaches found.

3. Use of the Principle that the Units Producing Pollution Treat It in Order to Achieve Effective Treatment and Comprehensive Utilization

In order to implement the treatment measures, we used dispersed treatment and applied the principle that the unit producing the pollution treats it; regardless of the quantity or degree of pollution, all waste had to be treated where it originated. Focusing primarily on the pollution-producing shops and departments, the research office environmental protection group assigned or selected pollution control projects. After the measures were decided on, their application and management were turned over to the shops. The emulsifier used with machine tools in the maintenance shop had an oxygen consumption as high as 20,000 mg/liter. Research led to the following approach: iron fragments and impurities were allowed to settle from the emulsifier, after which it was concentrated, purified, filtered and discharged. This discharge fluid met the standard with an oxygen content under 50 mg/liter, and equipment has now been built by the plant to treat the emulsifier once a month.

An energetic effort was made to develop methods for comprehensive utilization of wastewater. For example, comprehensive use was made of the shops' melt spinning furnace coolant water, which amounted to 70-100 kg a day, and whose main components were emulsifier and caprolactam monomer; the oxygen consumption value was very high and it could not be discharged, so it was concentrated, the oil separated from the water, and adsorption, recrystallization and distillation employed to obtain caprolactam equivalent in quality to the imported product, which could be sold. In addition, to use the polyethylene sacks in which the caprolactam was packaged, they were shredded and the caprolactam residue rinsed away. Some 600 sacks a day were used, and the wash water amounted to 100 kg a day. This had a content of 2 percent caprolactam and could not be discharged, but evaporation and distillation were used to recover it. The dining hall dishwater had a chemical oxygen demand (COD) greater than 10,000 mg/liter, and with the cooperation of the Donghai Fats and Oils Plant a well-type oil separating pool was constructed. Following separation in this pool, the wastewater met discharge standards. The waste oil was regularly skimmed off and sold for 0.10 yuan a kilogram. Each ton could be made into 5,463 bars of soap. This both decreased pollution and increased profits.

4. Strengthening Management and Research

While assigning and monitoring the performance of production plans, we also assign and monitor the performance of waste treatment plans and allocate waste treatment work down to the brigade level. Our plant monitors discharge water at the four main discharge outlets 8 times a month and monitors the 23 waste gas discharge points twice a month. The measurement results are posted on 25 bulletin boards in the shops, and in addition the various shops are rated on a scale of 1 to 100 in a bonus competition. The shops also develop methods for evaluating shifts, brigades and individuals. Maintenance cycles have been developed for waste treatment equipment, and this equipment is regularly serviced and overhauled. Equipment standards have been developed and are regularly checked, and this equipment is cared for along with process equipment. In addition, we have persistently carried out the "three simultaneous activities"; for example, treatment of wastewater from the chromium plating shop and treatment of waste gas from the plastics molding shop were handled in this way: the required equipment was designed, built and put into production concurrently with shop reconstruction. The Cr^{6+} content of the chrome plating wastewater was initially 100-300 mg/liter, but following installation of a titanium tube evaporator, the condensed water had a Cr^{6+} content of 0.005-0.01 mg/liter, meeting discharge standards. The research laboratory organized groups to deal with certain wastes that initially could not be treated. For example, the wastewater from the resin impregnation waste tank had a phenol content 10-20 times the standard and an oxygen consumption of 2,000-3,000 mg/liter, and particulate matter and color were also several times higher than permitted by the standards. About 3 tons of this water is produced each day. Abroad it is condensed and filtered, then spray aerated. Our plant had no area for aeration, but it successfully adopted a condensation method. Following treatment, the PH, OC, phenol content and particulate content all were in accord with discharge standards. We have built treatment equipment for this process.

Overall, although our plant is now treating virtually all wastes and discharges meet standards, discharge quality is still not steady, and the rate of compliance with the standard is still not fully 100 percent; the air in the shops is still somewhat turbid, and we have just begun to deal with noise. All of these problems await energetic resolution in the future.

8480
CSO: 5000/4025

SHANXI ENVIRONMENTAL POLLUTION AERIAL SURVEY MARKS START OF 5-YEAR PROJECT

Taiyuan SHANXI RIBAO in Chinese 15 Feb 82 p 1

[Article: "To Provide Scientific Data for Formulation of Regulations Concerning Treatment of Environmental Pollution of This Province, First Environmental Pollution Aerial Survey Conducted in Shanxi"]

[Text] Xinhua Taiyuan, 13 February: Yesterday, three special purpose aircraft flew over Taiyuan and its vicinity within an area of some 480 square kilometers and conducted six environmental pollution aerial surveys at various altitudes. At the same time, 41 ground observation stations scattered all over the city and its vicinity and six meteorological observation stations conducted multi-disciplinary general survey in close coordination with the aerial survey.

This constituted the first day's activities of an aerial survey over Taiyuan which is to last 10 days as part of a large-scale scientific research project entitled "Evaluation of Shanxi's Environmental Status and Preliminary Evaluation Study of Coal Energy Base."

This is the first large-scale aerial survey of environmental pollution carried out in China.

If we want to speed up the construction of Shanxi's coal energy base, we must confront the important problem concerning how environmental pollution can be controlled. The purpose of this aerial survey is to understand the overall pollution situation in the atmosphere over Taiyuan, to determine the content of air pollutant, to understand the laws governing transport and conversion of the pollutant, and the distribution of surface thermal pollution. The data thus gathered will provide scientific bases for the formulation of regulations and measures for combating the environmental pollution of Taiyuan city and Shanxi Province. This scientific research project is sponsored jointly by the Shanxi Provincial government and the Chinese Institute of Environmental Science. The early stage survey is initiated in the Taiyuan area, and will be conducted in general over various cities including Datong and Yangquan. The entire project is expected to last approximately 5 years.

9113
CSO: 5000/4028

HEILONGJIANG COMPLETES ANTIPOLLUTION PROJECTS

OW091246 Beijing XINHUA in English 1229 GMT 9 Apr 82

[Text] Harbin, 9 Apr (XINHUA)--Heilongjiang Province has completed construction of 641 anti-pollution projects since 1981, the province's environmental protection office announced here today.

The province can now treat 54 million tons of waste water, 27 million tons of waste gas and 540,000 tons of slags and industrial residue annually. A total of 4.2 million yuan may be saved each year by recovering building materials and metallurgical and chemical products from the waste and economizing on coal.

In the last few years, scientists have made surveys of water, air and land pollution. Last year 92 million yuan was earmarked for pollution control projects.

Now, many factories which were polluting the Songhua River have effluent disposal systems. Industrial slags and residue discharged into the river has been reduced by 34 million tons annually.

More fish have appeared in the Nenjiang River in western Heilongjiang where fish were nearing extinction a few years ago owing to organic pollution of the river.

The province authorities have also encouraged urban residents to plant trees and grow flowers to improve the environment and clear the air.

CSO: 5000/4032

REMOTE SENSING USED TO STUDY POLLUTION PROBLEMS

OW040203 Beijing XINHUA Domestic Service in Chinese 0030 GMT 3 Apr 82

[Excerpts] Beijing, 3 Apr (XINHUA)--At the recent third meeting on environmental study of the Beijing-Tianjin-Bohai Sea area, experts pointed out that air pollution in the Beijing-Tianjin area is mainly caused by particles, of which nearly a half are soil particles or sands blown by the wind.

Since 1980, the environmental scientific committee of the Chinese Academy of Sciences has organized over 200 scientists and technicians from 15 research institutes to study the atmospheric, land and oceanic environmental conditions of the Beijing-Tianjin-Bohai Sea area. In order to get a clear idea about the environmental pollution situation of the 34,000 square-kilometer Beijing-Tianjin-Bohai Sea area (excluding the coastal waters), scientists and technicians have made use of remote sensing technology. In addition, in order to understand the impact of Beijing City's air pollution on Langfang and Tianjin to its leeward, scientists and technicians have also used iron towers and low altitude sounding instruments to conduct comprehensive atmospheric experiments in the field. They have made systematic studies of the accumulation of pollutants in the freshwater ecological system as well as the control of water pollution by mercury.

After analyzing the quantity and variety of insecticides used by 609 communes in 34 districts and counties in the Beijing-Tianjin-Langfang area over the past 2 years, they have basically understood the situation of the use of insecticides in the area, the quantities of residual insecticides in the soil and their impact on underground water sources, and have drawn up charts by communes according to their findings. Their study shows that the principal threat to the Bohai Sea is pollution by organic matter.

CSO: 5000/4032

DAQING TREATS WASTE WATER, HAS CLEAN AIR

OW261257 Beijing XINHUA in English 0703 GMT 26 Apr 82

[Text] Daqing, 24 Apr (XINHUA)--Daqing oilfield, China's biggest, might also be the cleanest, according to the local newspaper DAQING BAO.

The oilfield, which produces an annual average of 50 million tons of oil, or half of the national total, is the only oilfield in China that can treat all waste water discharged in the course of oil extraction, according to the paper. The oilfield has 24 waste water treatment plants, which handle 480,000 cubic meters of waste water per day. These plants have in the past decade recovered 1.2 million tons of crude oil, the paper said.

Through treatment, waste water becomes clean and is re-injected into the oil-bearing strata to increase pressure and stabilize output, the paper said.

Air in Daqing is cleaner, too, now that most of the local apartments have central heating. More than 80 percent of the industrial and other boilers have been transformed in such a way that they no longer emit black smoke as in the past.

Tail gas of ammonia nitrate, or the "yellow dragon" as it is known to local people, has been eliminated since the Daqing oil refinery was fitted with special equipment.

Gas emitted by the refinery is recovered, too, the DAQING BAO added. It used to be burned away.

An environmental inspection station under the municipal government of Daqing regularly monitors possible contamination of air, water and soil and noise pollution. A similar station has been set up by the Daqing petro-chemical complex.

CSO: 5000/4041

CHINESE PLA ADOPTS MEASURES AGAINST POLLUTION

OW240233 Beijing XINHUA Domestic Service in Chinese 0740 GMT 22 Apr 82

[Excerpts] Beijing, 22 Apr (XINHUA)--Various units of the PLA have adopted effective measures against pollution in order to protect the environment and natural resources.

Environmental protection agencies of the PLA have conducted investigations in nearly 300 factories, hospitals, boiler plants, oil depots, harbors and wharves in order to have a good grasp of the sources of pollutants, and have formulated a long-term plan and measures for environmental protection. In the past 2 years, the PLA has done much to control pollutants from factories and hospitals and smoke and dust from boiler plants. Up to now, 1/7 of the pollutants from the PLA's chemical plants have been brought under control. Smoke-dispersing and dust-eliminating devices have been installed in boiler plants providing heat and bathing water for PLA units in Beijing, Shanghai, Tianjin and other big cities. In addition, plans have been drawn up to control pollutants from oil depots, harbors, wharves and booster agents for guided missiles. Technical research and experiments on how to control these pollutants are being conducted. Various units of the PLA have been actively using solar energy, residual heat and marsh gas. This has been very helpful in eliminating pollution and improving the environment.

To give a boost to the work of protecting the environment, which the PLA has been carrying out, the PLA general staff headquarters, general political department and general logistics department recently promulgated the Chinese PLA's provisional regulation on environmental protection. The regulation called on all PLA units to rationally use natural resources, protect the environment and prevent environmental pollution and ecological destruction. In building, remodelling or expanding engineering projects, antipollution facilities should be designed, built and put into operation at the same time to prevent the creation of new pollutants. Planned measures should be taken to control, according to the seriousness of the case, existing pollutants, such as harmful waste water, waste gas, residue, smoke and dust from boilers, noise, radioactive residue and radiation from electromagnetic waves. The regulation also stipulates that units which cause serious pollution, which refuse to take corrective measures, and which have failed to meet the required standard, even after taking corrective measures, will have to suspend production, shift to production of other lines, cease operation completely or be removed to another place.

CSO: 5000/4041

ECOSYSTEM PROJECT TO MAKE BEIJING MODEL CITY

OW101328 Beijing XINHUA in English 1202 GMT 10 Feb 82

[Text] Beijing, 10 Feb (XINHUA)--Beijing is launching the first urban ecosystem research project in its history of over 3,000 years in order to build the capital into a first-rate, modern city and a model for China, said a spokesman of the Chinese Academy of Sciences today.

Such research, said the spokesman, is a major scientific item. The project will center on the distribution of industry and agriculture, urban construction, energy supplies, water resources, food supplies and waste treatment. Based on ecological study and a recent large regional survey, the research will provide scientific basis for construction and planning of the city.

The spokesman added that urban ecosystem reserach has just begun in China. It is urgent and of great importance because Beijing as China's capital is the political center of the whole nation and the center of international relations, he said. The city is a place that people throughout China look to as a model. Beijing has a dense population with rich economic and cultural bases, he said.

The spokesman said that Beijing has already turned into a heavy industrial center due to excessive development of heavy industry and overextension of capital construction.

Of the total investment appropriated for industrial projects in the city up to 1978, 87.9 percent was used for heavy industry and 12.1 percent for light industry, he said. Heavy industry accounted for 63.7 percent of Beijing's total industrial output value in 1979 while light industry accounted for only 36.3 percent. "This phenomenon does not accord with the development of the capital or the municipal construction principle. This is the main reason of environmental pollution," he pointed out.

The population has increased enormously in Beijing, the spokesman said. Its urban population has grown from 1.2 million in 1949 to 9 million at present. Population density has increased from 5,000 per square kilometer to 12,000 per square kilometer. However, vegetation averages 5.1 square meters per capita, including two square meters of water space. Consequently, the environmental quality in Beijing is greatly reduced.

Excessive use of underground water in Beijing has lowered the underground water table by two or three meters in 1981 and created a hollow of about 1,000 square kilometers under the city proper and the outskirts, the spokesman added. As a result, nitric acid content in water is up and water pollution has become serious. The city planning department has predicted that by the year 2000, the city will need 5,100 million cubic meters of water. The water shortage is inevitable and will become more serious at that time, he warned. In 1981, Beijing suffered its worst water shortage in 32 years.

Urban ecosystem research in Beijing, the spokesman said, began last October and will be completed in 1985. The project is divided into three stages:

-- In the first stage, researchers will make comprehensive studies of natural conditions, population trends, urban construction, land usage, economic development and environmental quality, outlining urban ecological divisions, the social economy and the overall environment by the end of this year.

-- The second stage of the research, to be completed at the end of 1983, will center on the city's needs and available supplies of energy, water resources and vegetables. This stage will also study garbage treatment and the balance of vegetation and water space.

-- The last stage, to be finished in 1985, will concentrate on systematic study, evaluation and calculation in order to design models for construction of the city and provide scientific basis for the central government.

Sponsored by the Committee on Environmental Science of the Chinese Academy of Sciences, the research is also being conducted by four institutes of geography, botany, environmental chemistry and zoology, and the ecology center and other organizations in the city.

CSO: 5000/4027

BRIEFS

CHANG JIANG WATER QUALITY MONITORING--Wuhan, 10 Feb (XINHUA)--A water quality monitoring system has been set up along the Chang Jiang. At present, there are 178 monitoring stations along the river to monitor water quality, control water pollution and protect water resources. These monitoring stations have been built one after another since 1977 at such places as Dukou, Chongqing, Yichang, Shashi, Hankou, Danjiangkou and Nanjing along the main stream and major tributaries of the Chang Jiang by the bureau in charge of protecting water resources of the Chang Jiang and various provinces and municipalities located along the Chang Jiang. At the same time, monitoring vessels were developed and commissioned to trace down sources of pollution, go to the rounds to check water quality and protect water resources. More stations will be built in the future to further improve this monitoring system. [Beijing XINHUA Domestic Service in Chinese 0124 GMT 10 Feb 82 OW]

HUNAN ANTIPOLLUTION MEASURES--Changsha, 14 Feb (XINHUA)--Hunan Province has reduced pollution with the 1,051 antipollution projects put into service during the last 2 years, according to the provincial environmental protection office. The office said that the province can now treat each year 100 million tons of waste water, 5,000 million cubic meters of waste gas and 800,000 tons of industrial residue. By multipurpose treatment, the province will retrieve annually from the wastes 50 kinds of metallurgical products, chemicals and construction materials worth more than 50 million yuan, the office said. The province earmarked nearly 100 million yuan for pollution control in 1980 and 1981, said the office. Many pollution-causing factories along the Xiangjiang River have installed effluent disposal systems with an annual capacity of reducing industrial residue discharged into the river by 500,000 tons and treating 70 million tons of waste water before the water flows into the river. New factories also have been fitted with devices to tackle the pollution problem. [Beijing XINHUA in English 0716 GMT 14 Feb 82 OW]

CSO: 5000/4027 END